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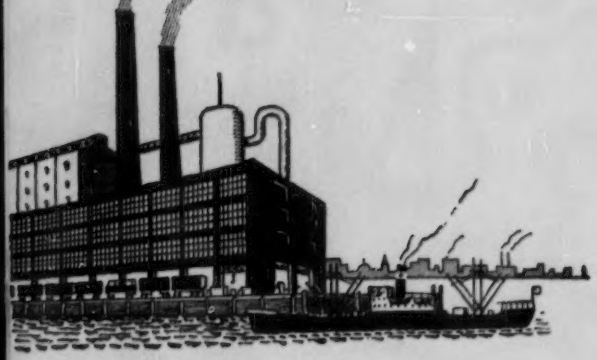

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ECONOMIC GEOGRAPHY

CONTENTS FOR APRIL, 1955

Prospects and Problems of the Port of Chicago . . . . *Harold M. Mayer* 95

The South Limburg Coal Field . . . . . *F. J. Monkhouse* 126

The Purpose and Source of Seasonal Migration to Alaska . *William J. Stanton* 138

The Zande Scheme in the Anglo-Egyptian Sudan . . . . *William A. Hance* 149

Summer Nomadism in Tunisia . . . . . *John I. Clarke* 157

Geographical Distribution of Petroleum Refining Capacities: A Study of the European Refining Program . . . . . *Alexander Melamid* 168

The Iron and Steel Industry of Turkey . . . . . *Erol Tümertekin* 179

Book Reviews

Pierre Gourou: The Tropical World . . . . . *O. H. K. Spate* 185

August Lösch: The Economics of Location . . . . . *H. H. McCarty* 186

Jacques Lambert: Le Brésil; Structure sociale et institutions politiques *Preston E. James* 187

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ECONOMIC GEOGRAPHY

VOL. 31 APRIL, 1955 NO. 2

PROSPECTS AND PROBLEMS OF THE PORT OF CHICAGO

Harold M. Mayer

Professor Mayer of the Department of Geography, University of Chicago, here combines his research interests in urban geography and the geography of transportation. He was formerly in planning work and has served as a member of the Chicago Regional Port District Board.

THE Port of Chicago is one of the major centers of water-borne commerce in North America, and it ranks high among world ports in volume of traffic. A number of recent events have focused attention upon its changing role in Great Lakes, inland, and overseas traffic.

Within the Chicago metropolitan area, a number of harbors and inland waterways together constitute the Port of Chicago (Fig. 1). The port includes five harbors on the shore of Lake Michigan, two of which are within the City of Chicago and three in the near-by Calumet region of northwestern Indiana. It also includes several inland waterways: the two branches of the Chicago River, the Chicago Sanitary and Ship Canal, the Calumet and Little Calumet rivers, Lake Calumet, and the Calumet-Sag Channel.[1]

The total traffic of the lake-front harbors and inland waterways of the Port of Chicago exceeds 60 million cargo short tons per year. Among American seaboard ports, this tonnage is exceeded only by that of New York Harbor and by the combined traffic of all of the Delaware River ports from Trenton to the sea.[2] Only one Great Lakes port, Duluth-Superior, exceeds the Port of Chicago in tonnage, and at that port, in contrast to Chicago, the traffic is limited to a very few bulk commodities, principally iron ore, coal, and grain.

STRATEGIC SITUATION

Chicago is unique among inland ports of North America in that it is the only port which handles on the one hand the traffic of the Great Lakes—as well as a growing overseas direct trade through the St. Lawrence—and on the other hand an important volume of traffic to and from points on the Mississippi River system, through the Illinois Lakes-to-Gulf Waterway. At the Port of Chicago the two major inland waterway routes of the continent meet (Fig. 2).

INLAND WATERWAY CONNECTIONS

The connection between the two waterway systems at Chicago is pos-

[1] The Port of Chicago, as here delimited differs from the Port of Chicago as delimited by the U. S. Corps of Engineers, which includes within the port only that portion within the State of Illinois.

[2] In 1951 the total unadjusted water-borne traffic of New York Harbor was 192 million tons; of the Delaware River, 86 million tons. U. S. Army Corps of Engineers, *Water-borne Commerce of the United States*, Washington, Nov., 1952.

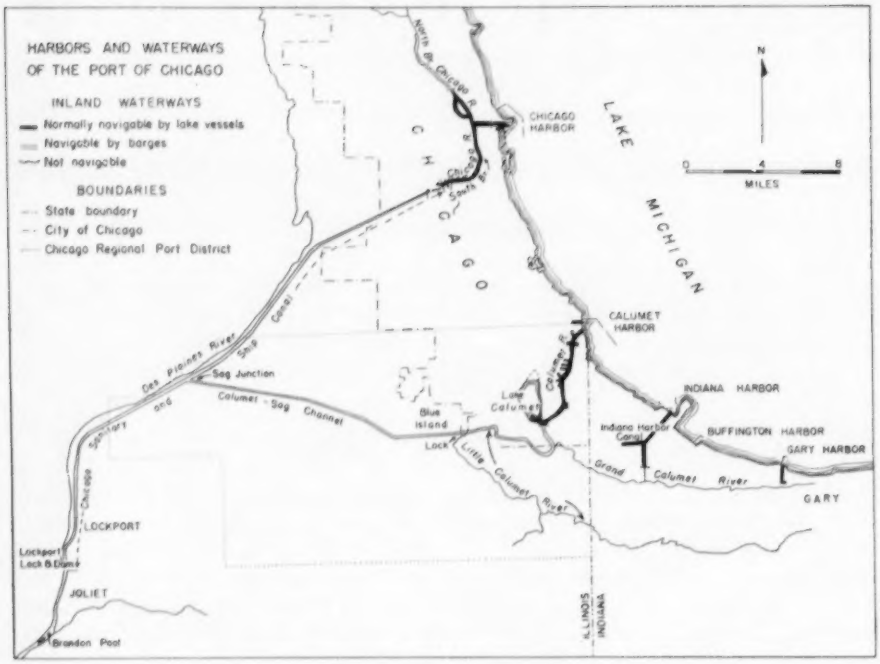

FIG. 1.

sible because within the metropolitan area just west of the city is the drainage divide between the Great Lakes and the Mississippi basins. There the divide is only a few feet higher than the lacustrine plain upon which the city is situated. The divide, furthermore, consists for the most part of a relatively unconsolidated moraine which was easily eroded by the meltwaters of the glacial Great Lakes when the St. Lawrence outlet was cut off by the receding continental glaciation. These meltwaters found their way across the divide at two points in metropolitan Chicago. The northernmost route, known as the Chicago Portage, was drained by the South Branch of the Chicago River flowing eastward into Lake Michigan and by the Des Plaines River flowing southwestward into the Illinois and thence to the Mississippi. The southern route, known as the "Calumet-Sag," was not naturally the course of any stream.

The Illinois and Michigan Canal, opened in 1848, utilized the low-gradient portage route between Lake Michigan and the Des Plaines. It was instrumental in opening up the prairies of northern Illinois to settlement, and carried substantial traffic—over a million tons per year—for several decades after the coming of the railroads. Finally, however, it was abandoned in favor of the more modern Illinois-Lakes-to-Gulf Waterway.

The divide was cut by a new artificial drainage channel, the Chicago Sanitary and Ship Canal, opened in 1900 primarily as a sewerage route. Its purpose was to divert the Chicago River away from Lake Michigan across the divide and thence into the Illinois and Mis-

50
90
80
70
TO EUROPE
BAIE COMEAU
PT ARTHUR
FT WILLIAM
DULUTH
SUPERIOR
SAULT STE MARIE
THREE RIVERS
QUEBEC
SOREL
MONTREAL
ESCANABA
MINNEAPOLIS
ST PAUL
GREEN BAY
ALPENA
TORONTO
HAMILTON
OSWEGO
MUSKEGON
SIOUX CITY
MILWAUKEE
THOROLD
ALBANY
BOSTON
BUFFALO
SARNIA
CHICAGO
DETROIT
ERIE
OMAHA
TOLEDO
ROCK ISLAND
GARY
SANDUSKY
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QUINCY
PEORIA
WHEELING
PHILADELPHIA
KANSAS CITY
CINCINNATI
BALTIMORE
E ST LOUIS
ST LOUIS
PT PLEASANT
EVANSVILLE
CHARLESTON
LOUISVILLE
CAIRO
NORFOLK
KNOXVILLE
MEMPHIS
CHATTANOOGA
WILMINGTON
MUSCLE SHOALS
BIRMINGHAM
CHARLESTON
VICKSBURG
SAVANNAH
HOUSTON
BATON ROUGE
MOBILE
JACKSONVILLE
50
GALVESTON
NEW ORLEANS
TO BROWNSVILLE
TAMPA
MIAMI
IMPORTANT PLACES
DIRECTLY ACCESSIBLE
BY WATERWAY
FROM THE
PORT OF CHICAGO
INLAND WATERWAY
CHANNEL DEPTHS
NINE FEET AND OVER
LESS THAN NINE FEET
0
300
MILES
HABANA
20
90
80

FIG. 2

sissippi rivers, thereby avoiding pollution by sewerage of Chicago's municipal water supply which was, and is, Lake Michigan. Great Lakes port and shipping interests, claiming to be adversely affected, were instrumental in securing an international treaty which limits diversion to 1500 cubic feet per second.

With the completion of a series of locks and dams in 1933, an all-year waterway with minimum depth of nine feet became available from Chicago to the Gulf of Mexico. The route follows the Chicago and Des Plaines rivers, and utilizes the Chicago Sanitary and Ship Canal between them. The latter, although originally mainly for sanitary purposes, was designed with reasonably adequate dimensions for barge tows. It has a depth of 21 feet as far as Lockport, 30 miles southwest of Chicago, where control works are located at the entrance to the Des Plaines. The canal has a minimum horizontal clearance of 160 feet. Fixed bridges, however, span the canal, with vertical clearance as little as 17 feet, thereby limiting normal commercial navigation to barges and towboats, and preventing use of the route by lake vessels beyond Western Avenue, six miles from Lake Michigan, where the northeasternmost fixed bridge is located. Lakeward of that point are numerous moveable highway and railroad bridges, principally of the double-leaf bascule type, which open to admit vessels, but in so doing disrupt land traffic and cause intolerable congestion, especially in and near Chicago's central business district. Closed hours have been established, during which times bridges in central Chicago are not permitted to open for vessels.

The second route connecting the Port of Chicago with the inland waterways of the Mississippi basin is the Calumet-Sag route, which connects industrial South Chicago with the Chicago Sanitary and Ship Canal through the Calumet and Little Calumet rivers and the 16.2 mile Calumet-Sag Channel. The Calumet River is utilized by lake and ocean vessels, as well as by barges, between Lake Michigan and the south end of Lake Calumet, a distance of six miles. That stretch of river is maintained with minimum depth of 21 feet and channel width of at least 200 feet, adequate for most lake vessels. All bridges are moveable, but three obsolete railroad center-pier swing bridges and several sharp bends in the channel cause difficulty. The Calumet River is lined on both banks by steel mills, chemical plants, grain elevators, shipyards, and other basic industries which depend upon both lakes and inland waterway transportation.

The southern end of Lake Calumet is maintained at a depth of 21 feet and is used by lake and ocean shipping, served by a general cargo terminal on the south shore of the lake. The rest of Lake Calumet is shallow and unimproved.

The Little Calumet River is presently navigable only by barges, because of channel depth of only nine feet and numerous low-level fixed bridges, including some which were recently constructed.

The Calumet-Sag Channel is a major bottleneck, the inadequacy of which prevents full utilization of Chicago's opportunities relative to the Mississippi inland waterway system. The Calumet-Sag Channel proper, from its easterly junction at Blue Island with the Little Calumet River to its westerly junction with the Chicago Sanitary and Ship Canal, is 16.2 miles in length. It has a channel depth of nine feet, but a width of only 60 feet. Completed in 1922, it was intended as a sewerage diversion channel. The Blue Island Lock, at its eastern end, has a

FIG. 3.

width of only 50 feet. Numerous fixed bridges have vertical clearances of as little as 14 feet. The large multiple barge tows, characteristic of the Mississippi and Illinois Rivers, therefore, cannot reach the Chicago area through the Calumet-Sag Channel. Enlargement of the channel constitutes one of the major potential physical improvements of the Port of Chicago.

In order to prevent reversal of flow of the Chicago and Calumet Rivers and thereby to reduce the danger of contamination of Chicago's water supply which is derived from Lake Michigan, two control locks were constructed. The one at the entrance of the Chicago River is 600 feet long and 80 feet wide, inadequate for the largest lake vessels to reach the Chicago River or the inner part of Chicago Harbor. Calumet-Sag Channel is controlled by the obsolete Blue Island Lock which restricts barges using that channel to a width of less than 50 feet.

LAKE-FRONT HARBORS

The two lake-front harbors in the City of Chicago and the three in the Indiana portion of the metropolitan area all accommodate lake and ocean shipping, and the two in Chicago are also accessible by inland waterway barges without the necessity of traversing the open waters of Lake Michigan.

Chicago Harbor, which includes the breakwater-protected area at the mouth of the Chicago River as well as about one-half mile within the river entrance, constitutes the original and historic Port of Chicago. The lakeward portion of Chicago Harbor consists of two parts, an outer harbor of 970 acres protected by a Federal breakwater and accessible to the largest vessels without lockage, and an inner 224 acre portion reached from the lake by passage through the lock (Fig. 3). There are at present no commercial terminals, and hence no traffic originating or terminating in the outer harbor. In the inner harbor, within the entrance of the Chicago River, are a number of terminals, including a general cargo facility used by overseas and lake vessels, several industrial wharves, and a temporary passenger terminal (Fig. 4). The few terminals that are now in use, however, are inadequate for the traffic that may be expected to develop if prospective waterway improvements, discussed later, are effectuated. Traffic in Chicago Harbor declined gradually after about 1890, when over seven million tons were handled, to a low point in 1943, when only 143 thousand tons were originated or terminated in that area. Since then, traffic has been increasing slowly to about 300 thousand tons per year, including some direct overseas traffic via the St. Lawrence River.

Calumet Harbor and River together constitute the principal port area of Chicago (Fig. 5). The Calumet district contains heavy, basic industries responsible for large bulk commodity movements by water. In the Calumet district, unlike the more centrally located area along the shores of Chicago Harbor and River, land is available for expansion of industry. Since 1906, the water-borne traffic of the portion of the Calumet district within the City of Chicago has exceeded the traffic in Chicago Harbor and River. In 1951, the latest year for which detailed statistics are available, over 23 million tons were received and shipped by water in the portion of the district within Chicago, as compared with only 287 thousand tons in Chicago Harbor. The shift to the Calumet district, which began in the 1880's, is, of course, associated with the growth of heavy industries in that area, and especially with the iron and steel industry.[3]

Calumet Harbor consists of a large breakwater-protected area in Lake Michigan, together with privately-developed slips serving large steel plants. The Calumet River, as previously mentioned, consists of six miles of channel

[3] John B. Appleton: "The Iron and Steel Industry of the Calumet District," *University of Illinois Studies in the Social Sciences*, Vol. 13, No. 2, 1925.

FIG. 4. Entrance of the Chicago River from Lake Michigan, looking eastward from downtown Chicago. The two series of breakwaters protecting outer and inner Chicago Harbor are visible as well as the control lock at the entrance of the Chicago River. Navy Pier is to the left (North) of the lock, and Lake Shore Drive Bridge in the foreground.

lined with numerous large industrial establishments. Except for a small portion of the river near Lake Michigan, access to and from the lake is through numerous railroad and highway bridges, which, although moveable, cause serious conflicts between water-borne and land traffic.

The public harbor in the Indiana portion of metropolitan Chicago, known as Indiana Harbor (Fig. 1), consists of a bifurcated artificial canal with depths of up to 26 feet, used regularly by the largest lake vessels. This canal, slightly over three miles long, is not directly connected with the inland waterway system of the Mississippi basin. It is completely lined with large industrial establishments including steel plants, oil refineries and terminals, and chemical plants. Indiana Harbor in 1951 handled over 16 million tons of water-borne traffic, nearly all of it in lake vessels. The traffic consists mainly of inbound iron ore and limestone, and outbound petroleum products, steel, and chemicals.

Two important private harbors along the Lake Michigan shore line of Indiana serve plants of the United States Steel Corporation. One, at Buffington, receives limestone for the Universal Atlas Cement plant, and in 1951 handled 1.3 million tons. The other harbor serves the Gary Works of the steel corporation. Gary Harbor handled 9.2 million tons of traffic in 1951, virtually all of it consisting of inbound iron ore from the Lake Superior area and limestone from northern Michigan. Since both Buffington and Gary harbors are private, no shoreline is there available for new industrial development.

TRAFFIC OF THE PORT OF CHICAGO

The volume of total traffic, and its distribution among the various portions

FIG. 5.

of the Port of Chicago, is shown for 1951 in Table I. Complete statistics for later years are not yet available.[4] It will be noted from the table that slightly over half of the traffic, as measured by cargo tonnage, of the Port of Chicago is handled in that portion of the port within Illinois, mostly within the City of Chicago. Of the harbors in Indiana, Indiana Harbor handles well over half of the traffic. Within the Illinois portion of the port, the Calumet district waterways, including Calumet Harbor, River, and Lake and the Calumet-Sag Channel, originate and terminate approximately two-thirds. Chicago Harbor and the two branches of the Chicago River together handle only about 10 per cent of the total traffic of the port within Illinois, and about 5 per cent

[4] Unless otherwise indicated, all traffic statistics in this article are compiled from various issues of *Annual Report of the Chief of Engineers, U. S. Army*, Washington, Gov't Printing Office. That publication is generally issued 18 months to two years after the period to which it applies. Some figures in this article are from advance releases of the Office of the District Engineer, U. S. Army, Chicago.

TABLE 1

WATER-BORNE TRAFFIC OF THE PORT OF CHICAGO

By harbor or waterway, by type, by direction of movement, 1951

(In cargo short tons)

Source: Compiled from: Annual Reports of Chief of Engineers, U. S. Army

Movement	*Chicago Harbor*[1]	*Chicago River, Main and No. Br.*[2]	*Chicago River, South Branch*	*Chi. San. and Ship Canal*[3]	*Calumet Harbor and River*	*Lake Calumet*	*Calumet Sag Channel*	*TOTAL Chicago, Illinois*	*Indiana Harbor*	*Buffington Harbor*	*Gary Harbor*	*TOTAL Indiana*	*TOTAL Port of Chicago, Ill.-Ind.*
TOTAL, originated or terminated	287,577	1,639,144	2,079,441	6,103,782	23,454,783	63,693	735,410	34,337,461	16,133,421	1,273,896	9,217,717	26,625,034	60,962,495
FOREIGN, total	245,941	0	39,546	74,311	1,742,270	48,234	0	2,150,302	167,016	0	21,000	188,016	2,338,318
Imports, total	229,992	0	34,013	0	455,269	27,592	0	746,866	144,160	0	21,000	165,160	912,026
Canadian	217,423	0	34,013	0	441,969	11,296	0	704,701	144,160	0	21,000	165,160	869,861
Overseas	12,569	0	0	0	13,300	16,296	0	42,165	0	0	0	0	42,165
Exports, total	15,949	0	5,533	74,311	1,287,001	20,642	0	1,403,436	22,856	0	0	22,856	1,426,292
Canadian	34	0	5,533	74,311	1,270,681	811	0	1,351,370	18,367	0	0	18,367	1,369,737
Overseas	15,915	0	0	0	16,320	19,831	0	52,066	4,489	0	0	4,489	56,555
DOMESTIC, total	41,636	1,639,144	2,039,895	6,029,471	21,712,513	15,459	735,410	32,187,159	15,966,405	1,273,896	9,196,717	26,437,018	58,624,177
Via N. Y. State Barge Can.	2,952	0	18,281	0	18,504	0	0	39,737	0	0	0	0	39,737
Receipts	2,952	0	14,555	0	0	0	0	17,507	0	0	0	0	17,507
Shipments	0	0	3,726	0	18,504	0	0	22,230	0	0	0	0	22,230
Lakewise, total	0	212,270	0	236,641	18,586,692	2,359	179,308	19,217,270	15,790,380	1,273,896	9,194,062	26,258,338	45,475,608
Receipts	0	212,270	0	49,042	15,349,967	0	1,422	15,612,701	10,431,047	1,145,539	9,194,062	20,770,648	36,383,349
Shipments	0	0	0	187,599	3,236,725	2,359	177,886	3,604,569	5,359,333	128,357	0	5,487,690	9,092,259
Internal, via Illinois Wwy.	38,684	1,346,565	1,954,753	5,663,620	2,340,798	13,100	525,256	11,882,776	83,404	0	2,655	86,059	11,968,835
Receipts	35,426	1,323,819	1,887,592	5,574,767	2,173,693	1,785	496,611	11,493,693	18,001[5]	0	730[7]	18,741	11,512,434
Shipments	3,258	22,746	67,161	88,853	167,105	11,315	28,645	389,083	65,393[8]	0	1,925[8]	67,318	456,401
Intraport, total[9]	0	0	0	26,369	0	0	26,369	26,369[4]	.....	0	0	0	[9]26,369[4]
Receipts[9]	0	0	0	26,369	0	0	0	.....[4]	.....	0	0	0	.....[4]
Shipments[9]	0	0	0	0	0	0	26,369	.....[4]	.....	0	0	0	.....
Local	0	80,309	66,861	102,841	766,519	0	4,477	1,021,007	92,621	0	0	92,621	1,113,628
CARGOES IN TRANSIT, total	922,487	668,025	1,898,040	3,429,749	287,368	0	2,398,097	128,054	.....	.....	.....	.....	.....
East and North	311,950	347,376	1,670,739	3,295,854	217,693	0	2,193,089	57,825	.....	.....	.....	.....	.....
West and South	610,537	320,649	227,301	133,895	69,675	0	205,008	70,229	.....	.....	.....	.....	.....

[1] Lake front, and Chicago River east of Rush Street.
[2] West of Rush Street, south of Addison Street.
[3] East of Sag Junction.
[4] Intraport movements totalled only once for Chicago, Illinois.
[5] Via Calumet Harbor: 17,044; via Chicago Harbor: 967.
[6] Via Calumet Harbor: 27,327; via Chicago Harbor: 38,066.
[7] Via Chicago Harbor.
[8] Via Calumet Harbor.
[9] Refers only to Port of Chicago, Illinois; movements between points in Illinois and Indiana excluded.

of the total water-borne commerce of the metropolitan area.

The water-borne traffic of the Indiana harbors is almost entirely in lake vessels, since the types of inland waterway barges in common use on the Mississippi River system including the Illinois Lakes-to-Gulf Waterway are not suitable for use on the open waters of Lake Michigan, and there is at present no direct connection between the Illinois Waterway and the harbors of Indiana. The numerous harbors and waterways of the Illinois portion of the Port of Chicago have considerable transfer of through traffic between the Mississippi and Great Lakes waterway systems, necessitated by the different physical conditions and types of vessels employed on the two systems.

Each type of traffic—lake, ocean, and inland waterway—plays an important role in the economic base of metropolitan Chicago.

LAKE TRAFFIC AND ITS HANDLING

Great Lakes traffic constitutes the major volume of water-borne cargo at the Port of Chicago. Chicago began as the westernmost terminal of shipping on the Great Lakes, and its importance as a port is still primarily related to its strategic lakeside location.[5] For many decades, the lake traffic of the Port of Chicago has consisted largely of bulk commodities associated with the heavy basic industries: iron and steel mills, chemical and cement plants, and oil refineries. This traffic is carried in specialized vessels of distinctive design,[6] and is handled by specially designed loading and unloading facilities. Continuous-flow characteristics of the commodities permit rapid cargo handling and turnaround of vessels at numerous facilities, most of which are operated in connection with large industrial establishments in the Calumet District of Illinois and Indiana.

Iron ore constitutes by far the greatest volume of cargo handled, accounting for about 25 million tons in a normal year received at Calumet River and Harbor, Indiana Harbor, and Gary, approximately one-third of which is received in the Calumet waterways of the City of Chicago, the remainder being about equally divided between Gary and Indiana Harbor. The ore originates very largely in the Lake Superior area, principally in the Mesabi Range, and is shipped from Duluth-Superior and Two Harbors. Smaller amounts are shipped from Ashland, Marquette, Escanaba, and other northern lake ports.[7]

Virtually none of the ore received at the Port of Chicago is transferred to inland carriers, but rather is consumed in the blast furnaces along the local waterways, which together, on January 1, 1953, had an annual capacity of 15.2 million tons of pig iron, or slightly in excess of the second largest producing area in the United States, the Pittsburgh district with an annual capacity of 14.9 million tons. The principal blast furnaces in the Port of Chicago, all of which normally re-

[5] For a detailed account of Chicago's lake traffic prior to development of the Illinois Lakes-to-Gulf and the direct overseas St. Lawrence waterways traffic, see: Richard Hartshorne: "The Lake Traffic of Chicago," Ph.D. dissertation, Dept. of Geography, Univ. of Chicago, 1924; and Hartshorne: "The Significance of Lake Transportation to the Grain Trade of Chicago," *Econ. Geog.*, Vol. 2, 1926, pp. 274-291.

[6] A voyage on a typical vessel of this type is described in: Albert G. Ballert: "A Turnaround on a Great Lakes Freighter," *Econ. Geog.*, Vol. 25, 1949, pp. 146–155.

[7] Of a total of 77.5 million tons of ore shipped from the Lake Superior district in 1952, a typical year, 59.5 million tons, or nearly 77 per cent, originated in the Mesabi Range. Compiled from: Lake Carriers' Association, *Annual Report*, 1952, p. 157.

ceive their iron ore by lake vessel, are the Gary Works of the United States Steel Corporation, the Inland Steel Company and Youngstown Sheet and Tube Company plants at Indiana Harbor, and a number of plants on Calumet Harbor and River, including the "South Works" of United States Steel Corporation, another plant of Youngstown Sheet and Tube, Wisconsin Steel works of International Harvester Company, and Republic Steel Company. These plants together in 1950 accounted for 23.9 million tons of iron ore receipts, or nearly 40 per cent of the total tonnage of water-borne commerce of the Port of Chicago.[8]

Limestone, the commodity which accounts for the second greatest volume of lakewise receipts at the Port of Chicago, is also primarily associated with the iron and steel industry, although a considerable proportion of the limestone is used in the cement industry, and some for road ballast and other purposes. The major proportion of the stone received at the Port of Chicago is used as a flux in the blast furnaces. In 1952 a total of 6.5 million tons was unloaded from lake vessels in the metropolitan area, mainly from the northern part of Michigan's southern peninsula.[9] Approximately one million tons of limestone per year are unloaded at Buffington Harbor for the Universal Atlas Cement plant. A considerable volume of the cement produced in that plant, about 120 thousand tons annually, is shipped from Buffington Harbor to other lake ports.

Although the volume of coal received at the harbors of the Port of Chicago has in recent years been considerably less than that received from inland waterway barges, bituminous coal constitutes the third greatest commodity, in tonnage, received from lake vessels. Only a very small proportion is consumed by the iron and steel industry. Most of the lakewise coal movements to Chicago originate in West Virginia and eastern Kentucky, and to a lesser extent Pennsylvania, and are loaded aboard vessels at Lake Erie ports, principally Toledo.[10] In spite of the convenient water-side location of the blast furnaces of metropolitan Chicago and availability of equipment for efficient discharge of coal cargoes from vessels, the movement of coking coal from Lake Erie ports to the Port of Chicago has been relatively small in recent years. Most of the coal moves from the Appalachian area by rail in spite of higher rates. This is due largely to a recent shortage of vessels for the ore trade and diversion to that trade of vessels formerly carrying coal. Such vessels no longer can afford delays of loading and unloading coal on return movements. With recent and prospective new vessels—about 40 bulk freighters since World War II—the shortage will soon be somewhat alleviated, and lakewise coal movements at the Port of Chicago may be expected to increase.[11] In 1952 a total of 4.6 million tons of coal was received at the Port of Chicago from lake vessels, including 970 thousand tons in Calumet Harbor and River,

[8] At the time of preparation of this article, final statistics by commodities were not available for later than 1950, and final statistics by waterway, harbor, and direction of movement, but not by commodity, for 1951. Preliminary statistics by commodity for domestic receipts and shipments only were available for 1952, a year in which a prolonged steel strike adversely affected movement of some commodities and resulted in slightly lower than normal total traffic for the Port of Chicago.

[9] The lake movement of stone is described in: Paul Cross Morrison: "Michigan Limestone in the Great Lakes Stone Trade," *Econ. Geog.*, Vol. 18, 1942, pp. 412–427.

[10] Arthur H. Doerr: "Chicago's Coal: Its Origin, Movement to Market, and Use," *Journ. Geogr.*, Vol. 49, 1950, pp. 261–269.

[11] Albert G. Ballert: "The Great Lakes Coal Trade: Present and Future," *Econ. Geog.*, Vol. 29, 1953, pp. 48–59.

232 thousand tons at Indiana Harbor, and only 13 thousand tons at Gary.

From Alabaster, Michigan, on Lake Huron, gypsum is shipped to the Port of Chicago, for use within and beyond the metropolitan area. Over half of the total Great Lakes gypsum traffic, all of which originated at Alabaster, is received at the United States Gypsum Company plant on the Indiana Harbor Canal. In 1952 receipts were 376 thousand tons.

Sand and gravel, other important bulk commodities, ranked high among lakewise receipts at the Port of Chicago. These commodities are dredged from the bed of Lake Michigan by specially designed steamers which discharge at various building material and contractors' yards on the Chicago and Calumet Rivers. Daily trips are made, and these craft are responsible for more bridge openings in downtown Chicago than any other single group of vessels.

Nearly all of the newsprint paper used in Chicago is imported from Canada by water. Two of the four daily Chicago newspapers, the *Tribune* and the *Daily News*, have printing plants and warehouses directly on the Chicago River, permitting direct unloading of vessels alongside. Paper for the other two newspapers, as well as for movement inland, is handled at a general cargo terminal, which also serves overseas vessels, at the entrance of the Chicago River. The *Tribune* carries on an integrated paper manufacturing and transportation operation. Pulpwood steamers, operated by a subsidiary company, carry pulp from the lower St. Lawrence to Thorold, Ontario, on the Welland Canal, where the paper is manufactured. From Thorold the same company's vessels transport the paper to the Chicago warehouse, adjoining the printing plant, in Chicago Harbor near the mouth of the river.[12]

The *Daily News* paper transportation is similar, except that, since some of the newsprint paper is manufactured at Three Rivers, Quebec, on the lower St. Lawrence, the vessels are of the "canaller" type, the dimensions of which are limited by the canals and locks which circumvent the rapids in the 112 miles of river between Montreal and Prescott, Canada (Figs. 6 and 7). The *Daily News* receives its paper directly from the vessels at its plant on the South Branch of the Chicago River, just west of the Central Business District. Unlike the *Tribune*, the *Daily News* does not own or operate paper manufacturing or transportation facilities. About 80 per cent of its paper requirement is supplied by mills at Three Rivers, Quebec, and at Fort William, Ontario. Another important user of water transportation for receipt of paper in Chicago is the Cuneo Press, which prints a number of leading national weekly and monthly magazines at its plant on the South Branch of the Chicago River. It receives large quantities of paper from lake vessels, as well as some manufactured in Maine and transported in specially-designed vessels through the New York State Barge Canal and thence the Great Lakes. Paper receipts at the Port of Chicago total from 250 to 300 thousand tons per year, mostly in one-ton rolls, the value of which is very high in proportion to the bulk.

Other lakewise receipts include Canadian grain, principally barley and rye, salt from Michigan which is received at the Morton Salt Company plant on the North Branch of the Chicago River, cement, scrap iron and steel, coke, ingots for further processing, and numerous other commodities.

[12] A detailed account of the manufacture and transportation of the *Tribune's* newsprint paper is contained in: Carl Wiegman: *Trees to News*, McClelland and Stewart, Toronto, 1953.

Lakewise shipments from the Port of Chicago are much less in volume than receipts—9.1 million as compared with 36.4 million tons in 1951—but of greater variety, and with much greater average value per ton. In these characteristics, the port is typical of those serving large metropolitan manufacturing centers, in which the outbound products are of less bulk but higher value than the inbound raw materials.

Over 80 per cent of lakewise shipments consists of fuels and allied products. Both coal and petroleum products are increasing in importance as outbound cargoes, the former mainly from the Calumet River and the latter from Indiana Harbor.

Lakewise coal shipments constitute one of the most rapidly growing movements at the Port of Chicago, and now amount to several times the volume of lakewise coal receipts. They also greatly exceed the volume of barge coal receipts from the Illinois Lakes-to-Gulf Waterway, in spite of the fact that coal constitutes the most important volume of any commodity moving on that waterway. Very little of the coal received at the Port of Chicago from inland points by barge, however, is transferred for further movement by lake vessel. Coal shipments from the port originate mainly in southern Illinois and Indiana and western Kentucky. The coal is not suitable for coking. Most of it is transferred from railroad cars to lake vessels at a new facility of the Rail-to-Water Transfer Company on the Calumet River, established in 1948 (Fig. 8). As late as 1946 the total lakewise coal shipments from the Port of Chicago consisted of 154 thousand tons, all from the Calumet River. Following establishment of the Rail-to-Water Transfer facility in 1948 the traffic has rapidly increased. At first a considerable proportion consisted of export shipments to western Canada for railroad use, but with dieselization of those lines the proportion of export to domestic coal shipments has decreased. In 1952 the Rail-to-Water Transfer Company alone loaded 4.2 million tons of coal aboard lake vessels, and that company recently announced plans for construction of a second loading machine which, together with expanded railroad yards nearby, will result in capacity of nine million tons per year. That volume of traffic will place Chicago third among Great Lakes ports in volume of coal shipments.[13] Most of the coal shipped from Chicago is consumed by industries and electric generating stations at other Lake Michigan ports.

Indiana Harbor is the most important harbor on the Great Lakes for shipment of petroleum products. In 1950 it handled over five million tons of refinery products, shipped to all parts of the Great Lakes. Along the Indiana Harbor Canal are a number of large refineries, connected with the mid-continent and Gulf Coast producing fields by pipelines. Lakewise shipments from these refineries are increasing rapidly. Since World War II a number of new, large tankers, including several formerly in ocean service, have been introduced to the Great Lakes petroleum trade.

Several of the newer oil facilities of metropolitan Chicago are located on the inland waterways, accessible only by barges and specially designed vessels. Most of these, on the Chicago Sanitary and Ship Canal, do not participate in direct lakewise traffic, but one, at Blue Island on the Calumet-Sag Channel, originates a unique traffic movement of refined products to Mil-

[13] Ballert, *op. cit.*, p. 54.

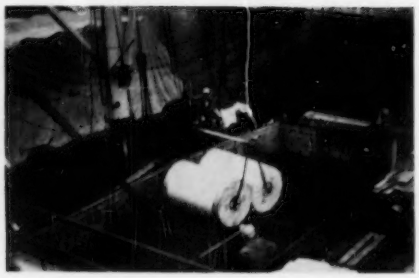


FIG. 6 (upper left). Discharge of newsprint paper from "canaler" type vessel at the *Chicago Daily News* plant on the South Branch of the Chicago River.

FIG. 7 (upper right). The newsprint, in one-ton rolls, is shipped directly to Chicago from the lower St. Lawrence through the existing St. Lawrence River and canal system.

FIG. 8 (lower left). Loading of coal at Rail-to-Water Transfer Company dock in the Calumet River. Over four million tons per year are shipped through this facility.

FIG. 9 (lower right). Grain elevators on the Calumet River. View southward from Ninety-second Street Bridge.

waukee[14] and other lake ports. It is unique because it is the only substantial regular movement on the lakes handled in towed barges rather than in deeper-draft masted vessels. The vessels and cargoes are self-insured, as underwriters frown upon such movements on the open lakes with shallow-draft barges of low freeboard. In 1950 the petroleum products moved lakewise in that manner from Blue Island amounted to 103 thousand tons, and the volume is growing.

Although characterized by great annual fluctuations, grain usually ranks third, behind coal and petroleum products, among the major groups of commodities constituting the lakewise shipments of the Port of Chicago. In spite of the fact that the grain movement on the Great Lakes, like the coal movement, has been handicapped in recent years by scarcity of shipping space because of heavy ore traffic, and also because of lack of elevator capacity at the receiving ports, the Port of Chicago in 1953 shipped 9.5 million bushels of corn, of which 3.7 million bushels were destined for Canadian ports. In 1953, lakewise shipments of all grains amounted to 14.4 million bushels, of which 9.5 million bushels were corn.[15] Well over half of the corn shipped from Chicago was unloaded at Buffalo or Oswego, New York.

[14] Edward Hamming: *The Port of Milwaukee*, The University of Chicago, Department of Geography, Research Paper No. 26, 1952, pp. 105–107.

[15] Chicago Board of Trade, *Ninety-sixth Annual Report for the Year Ended December 31, 1953*, Chicago, 1954, p. 15.

The expansion of soybean production in the Middle West in recent years is reflected in the fact that in 1953 soybeans constituted the second-ranking grain moving by lake vessel from Chicago, amounting to 3.0 million bushels, of which 2.8 million bushels were unloaded at Toronto.[16]

Wheat accounted for 3.0 million bushels of lakewise shipments from Chicago in 1952, but declined to 1.8 million bushels in 1953. In both years, as for many years in the past, the preponderant movement of wheat was to Buffalo.

Chicago ranks second among Great Lakes cities—behind Fort William-Port Arthur and just ahead of Buffalo—in grain elevator storage capacity, with a total of 59.7 million bushels.[17] Not all of that grain storage capacity is in water-front elevators, but ten very large elevators are located on water frontage accessible by lake vessels. All but one are on the Calumet River, which many years ago replaced the South Branch of the Chicago River as the focus of Chicago's water-borne grain movement (Fig. 9). One of the Calumet River elevators has a capacity of 16 million bushels.

Sulfur is a bulk commodity that moves through the Port of Chicago in considerable quantity, and that illustrates the role of Chicago as a transshipment port between the Illinois Lakes-to-Gulf Waterway and the Great Lakes. In 1952 the port handled 331 thousand tons of sulfur received from the Gulf Coast in barges, most of which was transferred to deeper-draft lake vessels for further movement. About one-fourth terminated at Canadian ports. The transfer takes place mainly at the Western Avenue facility of the North Pier Terminal Company at the eastern end of the Chicago Sanitary and Ship Canal (Fig. 10). That is the most inland point in Chicago normally accessible by masted lake vessels because of the fixed bridges across the canal to the west. A smaller volume is transferred near the mouth of the Chicago River and at the south end of Lake Calumet. The Port of Chicago thus performs an important transshipment function on a route, utilizing the two major waterway systems of North America, which is competitive with ocean-rail routes.

Other commodities regularly shipped from the Port of Chicago to other Great Lakes ports include iron and steel products, flaxseed, and sand and gravel.

The terminals formerly used at the Port of Chicago by lake passenger and package freight vessels have been demolished or reconstructed for other uses, and lack of suitable facilities may retard possible revival of those trades.

GREAT LAKES-OVERSEAS TRAFFIC

Aside from a limited scheduled barge service which is mentioned later, the only scheduled common-carrier freight services by water at the Port of Chicago are those which connect Chicago with overseas ports through the St. Lawrence route. Since inauguration of the first such service in 1933, the number of lines and vessels as well as the tonnage of freight traffic have increased rapidly year by year, the most rapid increase having been in 1953 and 1954. By the end of the 1954 season 12 companies were operating scheduled services between Chicago and overseas with small foreign-flag vessels, limited in dimensions by the canals and docks around the rapids of the St. Lawrence River above Montreal. The largest such vessels operating into the Great Lakes can carry about 1600 tons, and are 258 feet long, 43.5 feet wide, and with a draft through the canals of only

[16] *Ibid.*
[17] *Ibid.*, p. 19.

14 feet (Figs. 11 and 12). Eight of the lines connect Chicago with northwestern Europe, two with southern Europe and North Africa, and two with Caribbean ports. In addition to the scheduled liners, which had 216 round trips to Chicago in 1954, tramp vessels frequently reach the port. These services, liner and tramp, are growing rapidly in spite of the handicaps of opposition from eastern railroads and seaboard ports, with winter closure of the route, and with severe limitations upon the size and hence high costs of operation of the vessels. Rates between Chicago and overseas ports are 10 to 40 per cent lower than combination rail-water rates with transfer at east coast ports.[18]

Although the tonnage of cargo handled at the Port of Chicago by direct overseas services is only a small proportion—much less than 1 per cent—of the traffic of the port, it consists of diversified general cargo, the value of which, per ton, is many times that of the bulk cargoes which constitute the preponderant volume of port traffic.

The variety of commodities carried directly between Chicago and overseas ports is very great. Chicago receives iron and steel basic and fabricated products; aluminum concentrates, alloys, and scrap; beer, whiskey, and other alcoholic beverages; coal-tar products; special ores such as manganese; automobiles; and trucks. Toys from Germany, wines from France, tulip bulbs from Holland, marble from Italy, coffee from Venezuela, fish oil from Norway, and olives from Spain are but a few of the typical items unloaded in the Port of Chicago directly from overseas vessels, which return abroad with the manufactured products, foodstuffs and raw materials of the Middle West. Chicago ships directly overseas iron and steel products, manufactured food products, corn, petroleum products, and a wide variety of machinery.

As the westernmost terminal of the Great Lakes–St. Lawrence overseas route, Chicago is the most important beneficiary of the expanding volume of traffic and trade that is resulting from the increased volume of service on the route. Nearly half of the 300 thousand tons of traffic now handled annually by direct overseas vessels at United States Great Lakes ports is handled at the Port of Chicago. Unlike the Great Lakes and the Illinois Lakes-to-Gulf traffic, the loads in direct overseas movement are more nearly balanced in the two directions, thereby contributing to profitable operation of the services.

The volume of overseas general cargo traffic that the Port of Chicago can handle is limited by inadequacies of its terminal facilities. The three existing terminals which handle that traffic—one at the entrance of the Chicago River, one in the Calumet River, and one at the south end of Lake Calumet—are operating at capacity. Additional steamship lines would extend their services to Chicago if adequate terminals were available. Furthermore, many shipments originating in or routed through Chicago by land are loaded aboard vessels, or discharged, at Milwaukee and other Great Lakes ports because of the limited capacity of the Chicago terminals, and because of inability of the terminals to handle heavy or bulky shipments. No water-side crane, for example, is available at the Port of Chicago with a lifting capacity of over 15 tons, whereas the City of Milwaukee has several large cranes at its municipal port installations, includ-

[18] For a more detailed treatment of these services see: Harold M. Mayer: "Great Lakes-Overseas: An Expanding Trade Route," *Econ. Geog.*, Vol. 30, 1954, pp. 117–143. Because of that article, the subject is here treated very briefly.

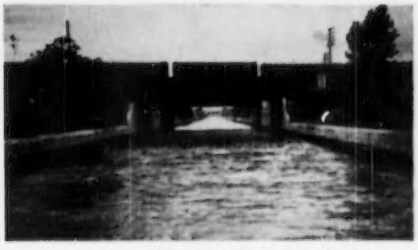


FIG. 10 (upper left). Transfer of sulfur from barge to lake vessel at Western Avenue on the Chicago Sanitary and Ship Canal.

FIG. 11 (upper right). M. V. *Laholm* of the Swedish American Line, a typical Great Lakes-Overseas vessel, in the Calumet River at the International Steamship Terminal, Ninety-fifth Street.

FIG. 12 (lower left). M.V. *August Sartori* of the Hamburg-Chicago Line. Another typical Great Lakes-Overseas vessel at the International Steamship Terminal, Ninety-fifth Street.

FIG. 13 (lower right). A portion of the Calumet-Sag Channel, showing narrow width and inadequate horizontal and vertical bridge clearances.

ing one with a 90-ton capacity. The result is that many movements of heavy machinery which otherwise would be handled at Chicago are transferred at Milwaukee, resulting in additional costs for the land haul.[19]

ILLINOIS LAKES-TO-GULF WATERWAY TRAFFIC AND FACILITIES

Since opening of the nine-foot channel of the Illinois Lakes-to-Gulf Waterway in 1933, Chicago has become a major port of the Mississippi River system, and the volume of traffic is increasing. It now exceeds by a wide margin the original estimates of ultimate traffic which were made prior to completion of the waterway project. The Illinois Lakes-to-Gulf Waterway traffic in 1951 constituted about 20 per cent of the total tonnage handled at the Port of Chicago and nearly 35 per cent of the traffic in the Illinois portion of the port (Table I).

Like the lakewise traffic, the traffic of the Port of Chicago via the Illinois Waterway is very unbalanced directionally. In 1951, for example, 11.5 million tons were received and only 456 thousand tons shipped. Also, as in the case of lakewise traffic, the outbound commodities are more varied and of higher average value per ton. The great majority of the barges move southward from Chicago empty.[20]

[19] Hamming, *op. cit.*, pp. 52–56 and 126.

[20] A comprehensive recent treatment of Chicago's inland waterway traffic is: J. Edwin Becht: "Commodity Origins, Traffic, and Markets Accessible to Chicago via the Illinois Waterway," Ph.D. thesis, Department of Geography, University of Illinois, published by The Illinois River Carriers' Association, Chicago, 1952. Because of that publication, the treatment of Illinois Waterway traffic in this article is very brief.

Northbound commodities received at the Port of Chicago from the Illinois Lakes-to-Gulf Waterway are principally fuels and bulk raw materials. Coal from central Illinois is the single leading commodity, constituting over four million tons of traffic per year. The greater proportion is received at generating stations of the Commonwealth Edison Company on the Chicago Sanitary and Ship Canal, the two branches of the Chicago River, and the Calumet River. A few other large industrial consumers, as well as some local distributors, receive barged coal. Since central Illinois coal is not suitable for coking, the iron and steel plants of the Calumet district do not receive barged coal.

Sand and gravel from the upper Illinois Valley is the second most important component of Chicago's inland waterway receipts. Its movement is short-haul to a number of large storage yards on the Chicago Sanitary and Ship Canal. The movement normally amounts to about two million tons per year.

Illinois Waterway movement of petroleum products is increasing in importance. Most of the petroleum products which are barged to Chicago originate at refineries on the Gulf Coast and along the Mississippi River and are discharged at "tank farm" terminals along the Chicago Sanitary and Ship Canal and in the Calumet district.

The Illinois Waterway is also increasing in importance as a route for transportation of grain to Chicago. In 1952 the barge movement amounted to 53.4 million bushels, and it constituted nearly one-fourth of the total grain receipts by all types of carriers at Chicago.[21] Nearly four-fifths of the grain in 1952 consisted of corn, and most of the remainder was soybeans, with small amounts of oats and wheat. Grain is received, for the most part, at the same elevators as handle lakewise movements, mainly along the Calumet River.

Sulfur from the Gulf Coast is transported to Chicago via the Gulf Intracoastal Waterway, the Mississippi River, and the Illinois Waterway in large quantities—331 thousand tons in 1952. Although some is used by the chemical plants of the metropolitan area, most of it, as indicated elsewhere, is transshipped to lake vessels for further movement.

Other commodities received at the Port of Chicago by barge from the Illinois Lakes-to-Gulf Waterway include sugar and molasses—187 thousand tons in 1952—from the Gulf Coast and the Caribbean area, sisal from Yucatan transferred to barges at New Orleans, iron and steel scrap and semi-finished products from St. Louis, Pittsburgh, and elsewhere, and a wide variety of industrial chemicals.

Although shipments by barge from Chicago are more varied than receipts, quantities of each commodity are small. Among the commodities shipped are iron and steel products, gasoline and other petroleum products, pig iron, coke, industrial chemicals, and miscellaneous manufactures. An important problem is the development of additional southbound barge traffic to overcome the great directional unbalance and thereby more effectively use the barges.

The Illinois Lakes-to-Gulf route was pioneered by the Federal Barge Lines, but an increasing number of private industrial and contract carriers have entered the trade. By 1952 only about 5 per cent of the Illinois Waterway traffic of the Port of Chicago was handled by the Federal Barge Lines.[22] That

[21] Chicago Board of Trade, *op. cit.*, pp. 2–3.

[22] Inland Waterways Corporation, *Annual Report, Fiscal Year Ending June 30, 1952*, p. 32 and U. S. Army Corps of Engineers, *Annual Report*, 1952.

organization, recently sold to private operators, is the only one that is used by less-than-bargeload movements. The sale includes a contractual obligation for maintenance of scheduled less-bargeload merchandise service on regular schedules, and should result in further strengthening of Chicago's position as the leading barge port of the Mississippi River system. In anticipation of increased traffic, the Western Avenue terminal was recently reconstructed with enlarged facilities.

Further development of barge traffic at the Port of Chicago is inhibited by inadequacy of the Chicago Sanitary and Ship Canal-Chicago River route, and to an even greater extent, of the Calumet-Sag route, both of which are now operating at beyond what was originally considered to be their ultimate capacities. Both waterways, and especially the Calumet-Sag, are too narrow for modern multiple tows, and both have numerous fixed bridges, with inadequate vertical and horizontal clearances (Fig. 13). The Sanitary and Ship Canal, furthermore, leads to downtown Chicago where little land is available for industrial development, and along the remainder of the route in metropolitan Chicago land is becoming increasingly scarce. The Calumet-Sag route, on the other hand, leads to the Calumet industrial area where, particularly in the vicinity of Lake Calumet, large tracts are potentially available for new and expanded industrial operations of types that can effectively use low-cost barge transportation for bulk raw materials as well as for finished products en route to Mississippi Valley and export markets through Gulf ports.[23]

At Brandon Pool near Joliet, 40 miles southwest of Chicago, tows are broken up northbound and assembled southbound in an operation analogous to assembling and breaking up of freight trains in a railroad classification yard. Northeastward from Brandon Pool, smaller towboats must be used and the tows cannot be operated with more than three moderate-sized barges with total capacity per tow of not more than 3 or 4 thousand tons as contrasted with as much as 20 thousand tons in the lower river (Fig. 13). The towboats are, for the most part, specially designed with low superstructures and retractable pilot houses in order to pass under the low fixed bridges (Fig. 14). This time-consuming and costly "switching" operation greatly increases the cost of barge service to and from the Port of Chicago[24] and has led to a movement on the part of Chicago industrialists for improvement of the Calumet-Sag route in accordance with the authorized Federal project.

PROSPECTS OF FUTURE TRAFFIC GROWTH

The long-term trend of traffic at the Port of Chicago has been sharply upward in all three of the major categories: lake, overseas, and inland waterway traffic. The two latter have each expanded into major factors in the economic base of metropolitan Chicago entirely within the last two decades, in spite of serious inadequacies of the waterways and terminals, and lakewise traffic has continued to grow. Both length and draft of the typical lake freighter are now considerably greater than prewar, and the dimensions and capacities are limited only by the depths and areas available in the harbors and

[23] Hjalmar W. Johnson: "The Steel Industry and the Calumet Sag Channel." Mississippi Valley Association, St. Louis, February 11, 1952, 26 pp.

[24] A vivid description is given in: J. Edwin Becht: " 'Turning Tows' on the Illinois-Mississippi Waterway," *Journ. Geog.*, Vol. 50, 1951, pp. 353–361.

connecting channels. The largest and newest vessels cannot now load to the maximum drafts for which they were designed. So urgent has been the demand for vessels in the lake ore trade that a number of ocean freighters have been converted for lake service, with increases in length and capacity. New lake vessels constructed in seaboard shipyards have been brought into the lakes through the Lakes-to-Gulf Waterway, being towed from tidewater to Chicago. To decrease their draft for the nine-foot channel, the vessels rested on pontoons, and to clear the bridges the superstructures were leveled. In one instance a 710-foot vessel was brought to the lakes in two sections and reassembled in Chicago. In order to accommodate these vessels, the normally fixed bridges over the Chicago Sanitary and Ship Canal were provided with temporary machinery for lifting, for which provision was made in the original design of each of the bridges. This procedure was similar to that used during World War II when small naval craft and cargo vessels constructed in Great Lakes shipyards were moved to salt water through the Illinois Lakes-to-Gulf Waterway.

Since the war, metropolitan Chicago has led the nation in the volume of new industrial plant construction,[25] and the expansion is continuing. The iron and steel, petroleum, and chemical industries, the area's principal users of water transportation, have been among the leaders in post-war expansion. In spite of new and expanded capacity on the eastern seaboard, the reduced reserves of high-grade Mesabi ore, and the recent and prospective new foreign ore sources shipped directly to east coast plants, the iron and steel industry of metropolitan Chicago has greatly expanded its capacity. In spite of that expansion, the plants of metropolitan Chicago do not produce enough steel to meet the demands of the region, and finished steel must be shipped from other areas. Optimistic estimates of the steel producers relative to the future of the industry in the Great Lakes area, and particularly in metropolitan Chicago, are evidenced not only by the greatly expanded plant capacity, but also by the large investments since the war in new lake freighters for the ore trade. These vessels are not suitable for the carrying of ore from overseas. New, large vessels have also recently been put in service in the limestone and cement trades on the lakes, and the tanker fleet is being augmented. There is little doubt that the bulk lake traffic of the Port of Chicago will continue to increase.

The traffic carried in direct ocean-going vessels between Chicago and overseas will, according to all present indications, continue to increase rapidly, even prior to enlargement of the St. Lawrence Seaway, in spite of the serious physical limitations of the present waterway, if suitable modern terminals for handling of general cargo become available at Chicago. Each of the lines now engaged on the route is planning or has under construction new vessels with dimensions suitable for passage through the present small locks of the St. Lawrence canals, and each is planning larger ships for use in the enlarged Seaway.

With completion of the Seaway project, expected within four years, vessels considerably larger than those now employed in the Great Lakes-overseas direct services will enter the lakes, and the Port of Chicago will be in direct competition with other lake ports, all of which are closer to the sea. The

[25] Commonwealth Edison Company *et. al.*, Territorial Information Department: *Industrial Expansion 1945–1952*, Chicago, December, 1952.

proportion of the Great Lakes-overseas traffic, and especially the high value general cargo traffic, that will use the Port of Chicago will depend upon the adequacy of depths in the harbors, the availability of modern cargo terminals for fast turn-around of vessels and prompt dispatch of freight, and the vigor with which local agencies promote and solicit the traffic.

The potential traffic of the Illinois Lakes-to-Gulf Waterway, likewise, is limited by the physical capacity of the route and by the availability of suitable terminals. Numerous interests in the Port of Chicago and elsewhere already are urging construction of a series of locks parallel to the existing ones between Lockport and the Mississippi in order to provide additional capacity and eliminate the delays which are increasingly common due to the fact that the existing single locks can carry only one-way traffic. There is also some discussion of the possibility of deepening the waterway from Chicago to the Gulf to 12 feet.

The most serious limitations on the potential traffic of the Port of Chicago via the Illinois Waterway route are imposed by the inadequacies of the channels in the Chicago area. The enlargement of these channels, and especially the Calumet-Sag, constitutes one of the most immediate needs of the port.

PLANNING AND ADMINISTRATION OF THE PORT

Unlike most ports, the Port of Chicago does not have a truly comprehensive official agency concerned with physical development and traffic promotion of the entire port area. This condition has, in the past, been reflected in a number of serious conflicts involving land and waterfront uses competing with port development.

There have been several comprehensive planning studies for the Port of Chicago,[28] some resulting in piecemeal improvements, some having no tangible effects, and some offering possibilities for the immediate future. In no instance, however, have the studies resulted in solution of the basic problem of coordinated port administration. Civic leaders and industrialists have long urged the creation of an official agency for port administration and operation having regional jurisdiction, overlapping the areas of the various municipalities, special *ad hoc* "district" governments, and the two states of metropolitan Chicago. Within the City of Chicago, numerous departments and bureaus with overlapping functions further complicate the port development problems.

The Chicago Regional Port District, created by the state legislature in 1951, represents the beginning of official port planning and development in Chicago by an agency especially created for that purpose. The Port District Board is appointed as a joint city-state agency. In the interest of political expediency the Port District was, and is, limited to a part of Calumet Harbor, the Calumet and Little Calumet Rivers, Lake Calumet, the Calumet-Sag Channel, and adjacent land areas (Fig. 1). When the Port District Act was amended in 1953 it was again considered politically inexpedient to expand the area of the District, although the powers of the board were enlarged to include issuance of revenue bonds for financing terminal development within the District. The District does not have taxing powers.

[28] Chicago Harbor Commission: *Report to the Mayor and Aldermen of the City of Chicago*, 1909; Commercial Club of Chicago: *The Harbor Plan of Chicago*, 1927; Hugh E. Young, Thomas G. Pihlfeldt, and M. W. Oettershagen: *Waterway Developments, Barge Terminals, and Bridge Clearances*, Chicago, Subcommittee on Bridge Clearances of the Committee on Harbors, Wharves and Bridges of the City Council of the City of Chicago, 1933.

Its initial appropriation was $40,000 for the 1951–53 biennium. That amount was not sufficient to initiate any improvements, but it enabled the Board to issue a comprehensive report recommending the major features of a port plan for the Chicago region, with emphasis upon terminals in Lake Calumet and enlargement of the Calumet-Sag Channel.[27] The 1953–55 appropriation of $100,000, together with the newly-acquired power to issue revenue bonds, will enable the Board to retain a small staff and to initiate development of a major terminal in the Calumet area. The terminal is to include several thousand feet of berthage in Lake Calumet, and transit sheds, warehouses, grain elevators, bulk liquid storage, and other facilities at the south end of Lake Calumet. These facilities are to be leased to private operators, the rentals to be used in amortizing the bonds. An initial $22.5 million development is planned.

Publication of the Board's first report stimulated interest in Chicago's port problems. One of the early results is evidenced by re-activation of several long-dormant promotional agencies in the Calumet area and by congressional interest in the Calumet-Sag project.

The Chicago Regional Port District, however, is not a comprehensive regional port agency. Its area is limited to within the State of Illinois, and to only a part of the port, although the most important part, within that state. It has not had the advantage of the existence of comparable agencies working in other parts of the port with which it could collaborate in a comprehensive plan for the entire regional port area, and, indeed, some consider it inexpedient politically for the board to undertake such joint planning. In particular, the creation of the Port District does not entirely meet the need for comprehensive port development for the interstate area of the Calumet district. Indiana has plans for developments which may be competitive with those being planned for Chicago. Joint study of the traffic potentials of the entire port area is required; and planning to insure that developments in all parts of the area will be complimentary and not competitive.

[27] *Where Two Great Waterways Meet; the First Biennial Report of the Chicago Regional Port District Board*, Chicago, February, 1953.

THE CALUMET-SAG PROJECT

The Chicago Regional Port District Board placed high upon its agenda the promotion of the Calumet-Sag improvement. It has succeeded in arousing considerable interest, not only that of local industrialists, but also of Federal agencies and Congress. The existing Calumet-Sag enlargement project was authorized by Congress in 1946 after investigation of economic justification.[28]

The Federal government, in spite of the fact that the improvement may be justified not only economically but in the interest of national defense, has been unwilling to proceed because of lack of evidence of local interest and the absence of an appropriate local agency concerned with port terminal development. The Chicago Regional Port District Act and the subsequent activities of the Board are important potential factors in stimulating local interest.

The Calumet-Sag project (Fig. 14) calls for the following: (1) widening of 10.4 miles of the Chicago Sanitary and Ship Canal between Lockport and Sag Junction from the present 160 feet to 225 feet; (2) widening of the Calumet-Sag Channel, 16.2 miles, from 60 to 225 feet; (3) replacement of the obsolete Blue Island Lock with one of more ade-

[28] 79th Congress, 2d session, House Doc. No. 677, *Illinois Waterway and Grand Calumet River, Illinois and Indiana*, Washington, Government Printing Office, 1946.

quate dimensions for barge traffic in the Little Calumet River just south of Lake Calumet; and (4) replacement of railroad and highway bridges which have inadequate clearance by modern structures. A later stage of the project as now authorized calls for improving the Grand Calumet River, not now navigable, as a barge waterway as far as the western part of Gary, and connecting it with the Indiana Harbor Canal, thereby providing access directly to the inland waterways by industries in the Indiana portion of the Calumet district.

Because of fluctuating prices it is very difficult to estimate the cost of the project. It was estimated by the United States Corps of Engineers and the Department of Commerce that, based upon 1940 prices, the benefit-cost ratio would be 3 to 1. Cost of the Federal project was estimated in 1946 at about 70 million dollars, excluding items required to be provided as local collaboration, such as spoil disposal areas and part of the costs of bridge replacement. Since then, the Truman-Hobbs Act, which provides for Federal participation in the cost of replacement of obsolete railroad bridges across navigable waterways of up to 90 per cent, has been amended to include also highway bridges. In the stretch of waterway to be enlarged in the initial stage of the project between Sag Junction and Lake Calumet, all 12 of the railroad bridges and 20 of the 28 highway bridges will require replacement. In addition, Acme Bend, a hazardous S-curve in the Little Calumet River, will require easing in accordance with one of five alternative plans which are under consideration. Furthermore, a difficult legal problem is involved in fixing of local responsibility for participation in replacement of four street bridges across the existing channel in the City of Blue Island.[29]

With completion of the Calumet-Sag enlargement and extension, Chicago will benefit from a reasonably adequate connection between its two major waterway systems—the Great Lakes and the Mississippi River systems. The existing channel with capacity originally estimated at one million tons per year is now carrying over three million tons annually, and the anticipated initial traffic in the enlarged portion between Sag Junction and Lake Calumet is estimated at 4.4 million tons, with an additional 4.7 million tons when the eastward extension in Indiana is completed.[30]

DEVELOPMENT OF LAKE CALUMET

Lake Calumet is the largest undeveloped area within the Calumet industrial district, and it offers opportunities for industrial expansion unique in metropolitan Chicago.[31]

The lake itself is a shallow body of water with average depth not much over three feet and with swampy shores. Its area is approximately 1800 acres, all owned by the City of Chicago. Adjacent undeveloped potential industrial land is many hundreds of additional acres in extent. The area is served by numerous trunk and belt line railroads, as well as by major highways, and by inland waterway, lake, and ocean shipping.[32] Its development has been neglected, largely because of lack of centralization of responsibility in a single agency. An official plan was adopted by the city in 1920, but violated by numerous encroachments of land uses

[29] Chicago Regional Port District, *op. cit.*, pp. 31–32.

[30] *Ibid.*, p. 22.

[31] Chicago Plan Commission: *Chicago Industrial Study, Summary Report*, 1952, pp. 48–49.

[32] Charles A. Blessing and Harold M. Mayer: *The Calumet Industrial District, A Preface to a Comprehensive Development Plan*, Chicago Plan Commission, 1942.

unrelated to either harbor or industrial development, including a very large garbage dump at the north end of the lake, and an express highway along the western shore using a route originally dedicated as an access facility to the harbor and industrial area in accordance with the 1920 plan.[33]

During World War II, the Federal government dredged a small portion of the south end of the lake to a depth of 21 feet, providing anchorage for lake vessels. A temporary shipyard was established near by, and immediately to the west of it the City of Chicago attempted to develop a shipping terminal, but the latter failed to materialize. The shipyard was later converted into Calumet Harbor Terminal, a private facility used by several overseas shipping lines.

The Chicago Regional Port District Board has recommended construction of a public terminal on the city dock property along the south shore of Lake Calumet, to be financed by revenue bonds and leased to private operators, a number of whom have indicated interest in the project. Preliminary estimates of potential traffic indicate that at least two thousand feet of vessel berthage, several transit sheds and warehouses, bulk liquid tanks, an additional 13 million bushels of grain elevator capacity, and many other associated facilities will be required for ocean as well as lake vessel and inland barge traffic. These terminal facilities are to constitute initial units in a comprehensive plan for industrial and harbor development of the entire Lake Calumet area.

Although Lake Calumet is not an ideal area for the development of the Port of Chicago's principal public terminal for the expanding Seaway and inland waterway traffic, it appears to be the best available area in view of the utilization of Chicago's Lake Michigan frontage by parks and existing industries, the shift of water-borne commodity traffic to the Calumet area over many years, and the difficulties of interstate cooperation and planning for harbor development on Lake Michigan straddling the state line. The interest expressed by many industries in utilizing the improved water transport that the proposed facilities will make possible, as well as inquiries relative to new industrial sites in the Calumet area, indicate that sufficient traffic will be available to justify the Port District Board's proposed project even before completion of the enlarged Seaway, and there are indications that a far larger development will ultimately be required. The proposed development, however, assumes improvement of the Calumet River.

CALUMET RIVER

The six miles of the Calumet River between Lake Michigan and Lake Calumet constitute an extremely important part of the Port of Chicago, and will become increasingly important with the development of Lake Calumet, in spite of existing inadequacies for navigation (Figs. 15 and 16). The project depth is 21 feet, and the river channel has been maintained at at least that depth for its entire length. It is not sufficient for the largest lake vessels fully loaded, and the industries inland from Lake Michigan along the river are somewhat handicapped as compared with those at the river entrance. The dimensions of vessels that can now transit the river are limited not only by the channel depth, but also by several bends and by numerous moveable bridges including three obsolete center-pier structures, the early removal of which is anticipated.

[33] Chicago Regional Port District, *op. cit.*, pp. 42–44.

The ocean-going vessels which will reach the Calumet River through the enlarged seaway, however, will not be as large as some of the lake vessels which now regularly traverse the Calumet River. With additional depth and easing of some of the bends, individual ocean-going vessels will experience no greater difficulty in the river than is now experienced by the lake vessels which operate through the river. The number of vessels using the river, however, may be expected to increase greatly.

Enlargement of the St. Lawrence Seaway, completion of the Calumet-Sag project, and harbor and industrial development of Lake Calumet will result in greatly increased vessel movements on the Calumet River. The channel will require some widening and straightening. Particularly serious is the situation of the main lines of the three largest eastern trunkline railroads—the Pennsylvania, New York Central, and Baltimore & Ohio—whose ten tracks cross the river on five moveable bridges only a mile from Lake Michigan. The number of openings of these bridges will greatly increase, and it is not feasible to replace them with high-level fixed bridges or with tunnels because of the steeper grades and long approaches that would be needed, difficult to provide because of numerous near-by junctions.

In order to accommodate ocean shipping which will reach Chicago through the enlarged St. Lawrence Seaway, the Calumet River channel will require deepening from the present 21 feet to 25 feet, initially, and eventually to 27 feet.

ILLIANA HARBOR

If difficulties of access to the Lake Calumet area through the Calumet River from Lake Michigan cannot be overcome, there will be need for expansion of facilities and extension of the protected area of Calumet Harbor on Lake Michigan. The Harbor Plan of 1927 suggested creation of artificial peninsulas jutting into Calumet Harbor at the Illinois-Indiana (Illiana) State Line.[34] Upon these areas would be constructed terminals and industrial plants with wharfage. The Regional Port District Board revived the suggestion, and recommended a more detailed study of the idea.[35] Such an area would have the advantage of direct access from Lake Michigan as well as protected access for barge traffic through the Calumet River. It would be adjacent to the main lines of the principal railroads serving the Calumet district, and near trucking arteries. On the other hand, only 1100 feet of shoreline are potentially available for landward connection and access, since all the remaining shore of Lake Michigan in that general area is in industrial, park, or other use. Furthermore, the access area is in Illinois, while the major part of the development must be in Indiana. The necessity for an inter-state port development agency is clearly evident.

BURNS HARBOR

There is no substantial, undeveloped shoreline fronting the existing harbors in Indiana. Industrial expansion along the south shore of Lake Michigan is imminent, and several large corporations are holding land along the lake shore in anticipation of future development of water front industries and associated harbor facilities. The State of Indiana has proposed a new harbor at Burns Ditch, an existing small drainage channel entering Lake Michigan eight miles east of the center of Gary. A large steel company is planning to

[34] Commercial Club of Chicago, *op. cit.*, p. 74.
[35] Chicago Regional Port District, *op. cit.*, pp. 73–75.

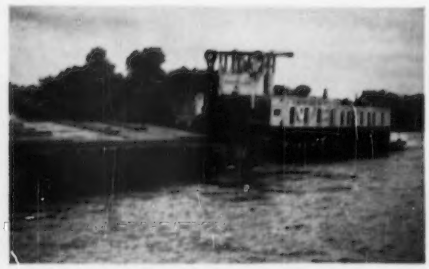


FIG. 14 (upper left). A towboat with retractable pilot-house, especially designed to shunt barges through the Calumet-Sag Channel.

FIG. 15 (upper right). Northeastern section of the Calumet River, from Ninety-second Street, showing entrance from Lake Michigan on the left, obsolete center-pier bridge of the E. J. & E. Railway, and a typical lake bulk freighter.

FIG. 16 (lower left). Calumet River and Turning Basin No. 3, northward from Ninety-fifth Street.

FIG. 17 (lower right). Lake Shore Drive Bridge, a typical double-leaf bascule structure, open to admit a vessel. Vessel transits in the Chicago River and in the Calumet River cause serious delays to land traffic. The vessel here proceeding lakeward through the Chicago River is the S.S. *North American*, since 1950 the only passenger vessel regularly serving the Port of Chicago.

build a plant at that location, and is holding extensive acreage. The State proposes to construct an extensive harbor with terminal facilities, including railroad yards and a coal loader. Considerable opposition has developed among residents of the near-by shore communities, and among those interested in conservation of the scenic resources of the Indiana Dunes. In the Burns Harbor proposal there is clear evidence of the necessity of considering the traffic potential of the entire Port of Chicago area in relation to a comprehensive plan. The Burns Harbor development will be directly competitive with the Illiana, Calumet River, and Lake Calumet harbor developments. A comprehensive study and a plan for development by an inter-state agency are required in order to prevent competitive duplication and at the same time to provide adequately for the requirements of the entire region.

CHICAGO RIVER BRIDGES

The conflict between land and water traffic resulting from opening of bridges on the Chicago River and its two branches for passage of vessels has received public attention for many years, with no satisfactory solution yet offered.

The main stem of the river from the Lake Michigan entrance to the "forks," a distance of approximately one mile, is spanned by nine bridges, all of the double-leaf bascule type (Fig. 17), carrying city streets, and with vertical

clearances in the closed position of from 17 to 25.5 feet above low water, thus admitting most barge traffic and specially designed low-clearance towboats without the necessity of opening. Virtually all lake and ocean vessels, however, require the bridges to be opened.

The South Branch of the Chicago River from the "forks" to the junction with the Chicago Sanitary and Ship Canal at Damen Avenue is spanned by 19 street bridges, all of the bascule type, with two additional ones under construction to carry a new express highway, and by four railroad bridges. These 23 bridges span the South Branch within a distance of less than five miles. When they are opened for passage of vessels, considerable delay to land traffic results. It is particularly of concern to the city and the public because many of the bridges are immediately adjacent to the Loop, carrying heavy traffic into and out of the downtown area.

Closed hours have been established, during which times the bridges are not opened, thereby seriously inconveniencing vessel traffic and reducing the usefulness of the river as a commercial waterway.

The downtown bridge problem has become somewhat less serious in recent years, partly as a result of the change in character of Chicago's lake traffic and the virtual disappearance of passenger and package freight vessels most of which formerly had terminals on the river, and partly because of the shift to the Calumet district with emphasis upon bulk traffic. Although the traffic on the Chicago River has been again increasing during the past several years, the annual number of bridge openings has been steadily decreasing. Fewer lake vessels and more barges use the river.

Considerable attention has been devoted to the possibility of eventually replacing the moveable bridges with fixed bridges, thereby entirely limiting movement on the Chicago River and its branches to vessels with low superstructures, and eliminating lake and ocean vessels. The opening of the enlarged Calumet-Sag Channel will divert a large proportion of the bulk traffic from the Chicago River to the Calumet district. Much of the remaining traffic could be handled in Chicago Harbor if suitable facilities were constructed there, and interchange of cargoes between barges on the one hand and lake and ocean ships on the other could take place in Chicago Harbor, eliminating the necessity for masted vessels to enter the Chicago River.

North Branch of the Chicago River

Unlike the other portions of the Chicago River, the north branch is a "dead end" waterway, not connected as a link in a through route. The bridge problem on the North Branch, however, is scarcely less acute than on the other portions of the river. It may be solved as the result of eventual official recognition of the change that has taken place in recent years in the character of the North Branch as an artery of water-borne commerce.

The channel in the North Branch is maintained as a Federal project from the "forks" to North Avenue, a distance of slightly over two miles. Beyond North Avenue the channel is usable only by barges and small pleasure craft. Numerous bridges between there and Addison Street are all moveable. Clearances of some are very restrictive in the closed position, and the narrowness of the channel, together with the sharp bends, makes navigation slow and difficult. North of Addison Street, the bridges are fixed and navigational use of the river is negligible.

Although there is an almost continuous band of industry on both banks of the North Branch, most plants do not use water transportation. Many of those which formerly did have relocated or gone out of business. The principal users of lake transportation remaining on the North Branch are sand and gravel yards and the Morton Salt Company, both south of North Avenue. Movements on the North Branch by lake vessels are rather infrequent, even south of North Avenue, while north of that point the restrictive channel depth prevents access except by barges. The largest user of barge transportation on the North Branch is the Commonwealth Edison Company, which receives large tonnages of barged central Illinois coal at its generating station located immediately south of Addison Street bridge. Nearby are several small boat yards which build and repair yachts and small wooden naval craft, the movement of which often requires bridge openings downstream. A substantial business in winter lay-up of small pleasure craft is also responsible for numerous openings of the downstream bridges.

While it is unlikely in the near future that a fixed bridge policy will be feasible south of North Avenue, such a policy is being considered by the City of Chicago for the portion of the waterway between North Avenue and Addison Street, involving eight city street bridges which would be fixed with adequate clearance for towboats and barges, but not for lake ships. Political pressures, largely on the part of the bridge-tenders, has until now prevented inauguration of such policy.

DEVELOPMENT OF CHICAGO'S LAKE MICHIGAN SHORE LINE

The development of the Lake Michigan shore line within the City of Chicago has been the subject of great public concern, frequent litigation, and political controversy for over a century. Use of the lake front as an almost continuous park area has given Chicago a unique and priceless civic asset. No other major Great Lakes city has as large a proportion of its lake frontage devoted to park use.

Most of the lake front park development is on artificial land, created by filling. Of a total of 25.2 miles of Lake Michigan shore line within the City of Chicago, only 3.0 miles is devoted to industrial and port use.[36] Most of it is frontage of the steel plants at the entrance of the Calumet River. The remaining 22.2 miles of shore line is for the most part permanently dedicated to park use and is consequently unavailable for port development. Increasing size of lake vessels and the imminence of large ocean freighters with enlargement of the St. Lawrence Seaway makes provision of deep harbors, industrial sites, and adequate terminals for both bulk and general cargoes imperative. Such developments should be located along the Lake Michigan shore line where vessels may have easy access from the lake without the necessity of transiting the narrow river channels with their numerous bridges, involving delays to land as well as water traffic.

The City of Chicago, by ordinance in 1911, designated areas along the lake shore as "harbor districts" permanently dedicated to harbor use. Two such districts embrace portions of the Lake Michigan shore line within the breakwater-protected area of Chicago Harbor, north and south of the Chicago River entrance. A third includes a mile of shore line on the Near South Side of the city, from 16th to 31st Street, an

[36] Chicago Regional Port District, *op. cit.*, p. 69.

area which subsequently was used for lake-front park and for a small municipal airport, which has poor landward rail and truck access, and which consequently will probably never be used as a port area. A fourth harbor district includes the lake frontage of steel mills on both sides of the Calumet River entrance within the protected area of the Calumet Harbor breakwaters.

THE FUTURE OF CHICAGO HARBOR

There is now virtually no existing shore line available within the designated lake-front harbor districts for industrial or port terminal development. Within Chicago Harbor, the lake shore line of Harbor District No. 2, south of the Chicago River entrance, is owned by the Illinois Central Railroad, and the development of facilities in that area will be dependent upon the policies of that organization. The shore line of Harbor District No. 1, slightly over one-half mile, north of the river entrance, is in public use for parks and highways. The northern portion of that shore line is fronted by Lake Shore Drive, on the landward side of which is a neighborhood of high-rise luxury apartment buildings and hotels, and a number of major institutions, including the Chicago campus of Northwestern University, all developed after the opening of the Michigan Avenue Bridge across the Chicago River in 1920, and nine years after dedication by the City of the adjacent water areas for harbor use.

Whereas the shore line within the harbor district south of the river entrance is accessible from the lake only by passage through the control lock, which limits dimensions of vessels and prevents access by the larger lake ships, the shore line north of the river entrance is part of the outer harbor, with access possible by vessels of any dimension, limited only by the depth of water available in the harbor.

In order to accommodate the largest lake vessels and large ocean freighters, a minimum depth of 27 feet will be required alongside wharves, as compared with existing depths of 21 feet, and in places less. No terminal facilities are now in operation in the outer Chicago Harbor north of the river.

Because of the limited capacity of the existing terminals elsewhere in the Port of Chicago which are now used for the overseas general cargo trade, the need for ship-barge transfer on the lake front if the Chicago River bridges are eventually fixed for barge transit only, the increasing possibility of a revival of the passenger services on Lake Michigan, and the prospects of early completion of the St. Lawrence Seaway project, there is already a demand for port terminal facilities in Chicago Harbor, to handle general cargo, as distinguished from bulk cargoes which will continue to be handled in the Calumet district.

In 1914 the City of Chicago completed a large pier, now known as Navy Pier, in the Chicago outer harbor north of the river entrance. The pier is 3000 feet long and 292 feet wide. It formerly handled most of Chicago's package freight and passenger vessels, many of which lost their Chicago River terminals with completion in 1925 of Wacker Drive, a double-decked street along the south bank of the Chicago River. During World War II the pier was devoted to military purposes not directly connected with lake navigation. More recently it has been diverted to other uses, including the housing of conventions, city and Federal offices, and an undergraduate branch of the University of Illinois. Although the pier is designed for loading and discharge of vessels through side ports, a type of

operation which disappeared with termination of package freight services on the lakes, it could possibly be reconstructed, with rail access extended from the near-by Chicago and North Western line, and with side aprons, possibly equipped with heavy-lift cranes for working cargo moving on ocean as well as lake ships and barges. Termination of the existing pier leases and reconstruction of the pier as a marine terminal would be the first step in the revival of Chicago Harbor as the principal area of the Port of Chicago for handling of general cargo. Additional piers could be constructed parallel to Navy Pier if and when needed.[37] Such facilities, together with dredging alongside and in the harbor entrances and anchorages to a depth of 27 feet, will greatly facilitate the handling of a considerable proportion of Chicago's potential general cargo traffic.

The conflict between port and alternative uses of the shore line within Chicago Harbor is typified by recent litigation relative to the area immediately north of Navy Pier, within Harbor District No. 1. The City of Chicago, in spite of adverse recommendations by the Chicago Plan Commission and many other agencies, and in spite of the availability of a number of alternative sites, began the construction of an artificial peninsula of 70 acres, upon which it intended to construct a filtration plant to treat the water supply of the northern half of the city and adjacent suburban areas. Although the southern half of the city receives filtered water from a lake-front plant on the South Side located outside of any harbor and in shoal water, the proposed Central and North District plant was to have been located within Chicago Harbor and within Harbor District No. 1, encroaching upon a designated anchorage area and seriously restricting the movement of vessels in the remaining areas of the harbor. A group of property owners in the near-by area brought suit, maintaining that the plant would encroach illegally upon navigable waters, and that the various local municipal bodies had no right to develop the riparian area for such purposes.[38] An injunction was issued on August 28, 1953, to prevent the construction of the filtration plant at the proposed site within the harbor. Three million dollars had already been spent upon engineering and sub-aqueous construction. The injunction was appealed, and the Illinois Supreme Court reversed the findings of the lower court, permitting the resumption of construction. The public interest which the filtration plant controversy aroused in problems of port and lake-front development, if sustained by adequate promotional and educational activities by a port development agency, could well be an important asset to the port's future. In any event, it is now clear that, in the near future, Chicago Harbor will be provided with some general cargo terminal facilities, complementary to the much larger facilities which are planned for the Calumet area.

CONCLUSION

The Port of Chicago is about to experience an important change in the character of its traffic, concomitant with a large expansion of its facilities. The enlargement of the St. Lawrence Seaway and the completion of the Calumet-Sag Channel will give the port much improved connections with the Atlantic

[37] One among many possible designs for such development is shown in: Chicago Regional Port District, *op. cit.*, pp. 71–73.

[38] Circuit Court of Cook County, No. 52C 7425, *Complaint* Filed June 23, 1952.

Ocean on the one hand, and with the Mississippi Valley and the ports of the Gulf of Mexico on the other.

A beginning has been made in the direction of providing terminal facilities for the anticipated great expansion of the water-borne commerce of the Port of Chicago. If the port is to realize fully its potentialities, however, much more effort is required in order that a comprehensive regional port plan may be developed and effectuated, without regard to the arbitrarily delimited area of jurisdiction of any one agency, municipality, or state. Meanwhile, the Chicago Regional Port District's plan for a Lake Calumet terminal is to be promoted in order that the Chicago area may have facilities to attract its share of water-borne traffic and associated industrial expansion. Chicago's situation at the junction of the two major inland waterways of North America offers unique opportunities for further development as the continent's major inland port.

THE SOUTH LIMBURG COAL FIELD

F. J. Monkhouse

Professor Monkhouse is head of the Department of Geography in the University of Southampton. His "The Belgian Kempenland" was published in 1949; more recently, he collaborated with H. R. Wilkinson on "Maps and Diagrams," and in 1954 his book, "Principles of Physical Geography," appeared.

THE only exploited coal field in the Netherlands lies in the extreme south of the country, in the province of Limburg. This province consists of a curiously shaped "appendix" that projects southward between Germany and Belgium for more than 25 miles and widens from a narrow corridor 3 miles across to more than 20 miles further south. Its history has been complicated. It was granted by the 1839 Treaty of London to the King of Holland in a personal capacity, but was not fully incorporated into the Kingdom of the Netherlands until 1867. It is a curious fact that though the Limburg coal field is probably the oldest to have been worked in continental Europe, its modern development is more recent than that of any other, with the exception of its neighbor to the west, the Kempenland field of northeastern Belgium.

Geology

The coal fields of western Europe are strung out in a series of disconnected basins of Upper Carboniferous rocks along the northern edge of the central European uplands. In Germany the small Aachen and Eschweiler fields, near the western frontier, are separated from the great Ruhr-Westphalian field to the east of the Rhine by the down-faulted basin of the Köln "bay" filled with new sedimentary rocks. The coal-bearing Upper Carboniferous strata can be traced more or less continuously westward from the Aachen field over the German-Dutch frontier, across Limburg, beyond the Meuse (which here forms the Belgo-Dutch frontier), and on across the Kempenland towards Antwerp. The Coal Measures are, however, "hidden"; that is, they are covered by a varying thickness of newer rocks—in Limburg by Cretaceous rocks, themselves overlain by recent clays, marls and sands, and in the Kempenland by vast thicknesses of Lower Pliocene sands and gravels.

These Coal Measures dip northwestward; thus, fortunately for the Netherlands, workable coal seams are found at about 300 feet below the surface in the extreme east, and at about 1400 feet near the Belgian frontier. In Belgium the depth at which workable coal occurs increases rapidly northwestward—at 1500 feet in the east, and at 3000 feet in the west of the conceded area, whereas farther west still (between Turnhout and Antwerp), coal not as yet economically workable has been proved at depths considerably below 3000 feet.

The total thickness of the Upper Carboniferous rocks in Limburg is estimated to be about 10,000 feet, but much of this consists of barren strata of sandstone and slate. The coal seams vary in thickness from about 2 to 8 feet. They are however con-

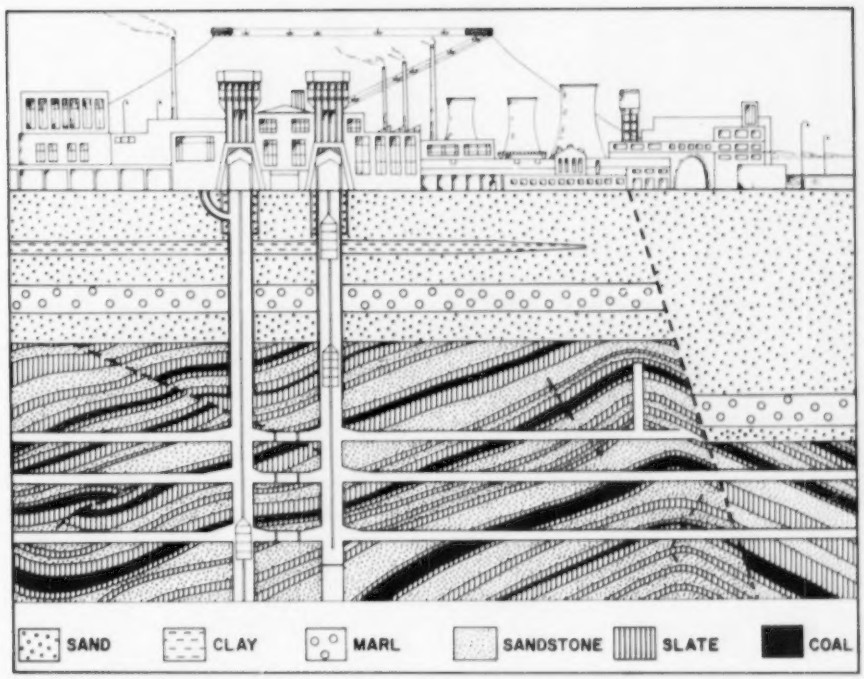


FIG. 1. Diagrammatic section of the Maurits Colliery. (Based on drawings made by mining engineers and geologists of the Maurits Colliery.)

siderably disturbed, both by folding and faulting, as shown by a diagrammatic section of the terrain below the Maurits colliery (Fig. 1). Moreover, many of the seams are interlaminated with "dirt," and careful washing is necessary. One great advantage however is that coal is found of wide variety; about half of the output consists of high-grade coking-coal, and ten per cent is anthracite. In all, there are estimated reserves of some 3000 million tons in the province, of which about one-third lies within the various existing concessions.

Almost all the coal is extracted by pneumatic coal picks; very few coal cutters are used. The normal method of extraction is by the long-wall system, using mechanical conveyors. As a result of the installation of new equipment since 1945, the output per man per shift in December, 1950, was 1.7 tons, the highest figure in western Europe. It is interesting to note that the accident rate among underground workers is the lowest in the world.

The importance of this field to the Netherlands is that as yet it affords the only exploited basin. It is true that the *Rijkspsporing van Delfstoffen* (the mines survey department), which is associated with the *Rijks Geologische Stichting* (geological survey), has proved the existence of a further deep field below the heathlands and bogs of the Peel, a desolate area that extends westward across northern Limburg into the province of North Brabant. These coal deposits are separated from the South Limburg field by a great down-faulted trough, where the Upper Car-

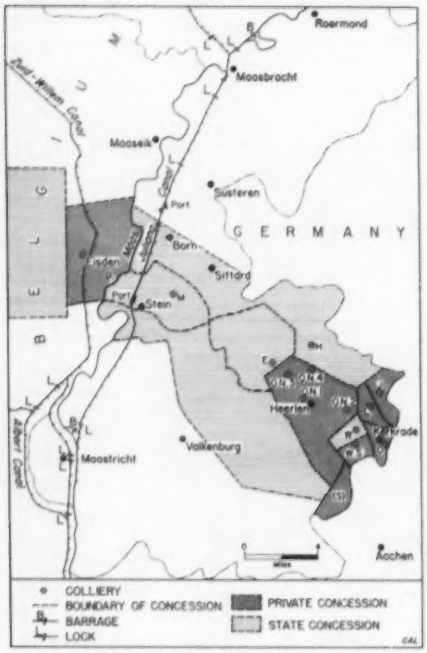


FIG. 2. Concessions and collieries of the South Limburg coal field. This field extends to the international frontier, which follows the center of the river Meuse from just north of Maastricht to a point below Maasbracht, where the river passes wholly into Dutch territory. West of the Meuse lies the Eisden concession and the State Reserve in the Belgian Kempenland field. Letters are used to indicate names of individual collieries as follows: D. Domaniale; E. Emma; H. Hendrik; J. Julia; L. Laura; M. Maurits; W. Wilhelmina; O.N. Oranje-Nassau; W.S. Willem-Sophia. Based on P. R. Bos and J. P. Nietmeyer, *Schoolatlas der Geheel Aarde*, Plate 11B (Groningen, 1936).

boniferous strata have been carried down to 8000 feet below the surface. This Peel field has coal seams at between 2500 and 3000 feet, certainly accessible by modern techniques, although the immense development costs that will obviously be entailed have so far precluded any initial exploitation. Other hidden fields have been proved farther north in Overyssel and Gelderland, but are thickly covered by newer rocks.

HISTORY OF DEVELOPMENT

As already mentioned, the Limburg field was probably the first to be worked in Europe, for it is recorded that the monks of Kloosterrade Abbey in 1131 mined coal by open-cast methods in the valley of the Wurm near the German frontier. Further sporadic operations were carried out during the succeeding centuries, but only on a small scale; in 1845, for example, some mining took place to supply fuel to operate the newly opened Maastricht-Aachen railway.

It was not until 1895 that the first large-scale concession was granted to the Domaniale Company at Kerkrade, and during the next five years further leases were obtained by the Laura and Vereniging Company at Eygelshoven, by the Willem-Sophia Company at Spekholzerheide, and by the Oranje-Nassau Company with its headquarters at Heerlen. These four companies were initially floated by French, German, and Belgian interests. The extent of these four concessions and the location of the eight collieries developed are shown on Figure 2;[1] they are all in the extreme southeast. The most recently opened of these private collieries were Julia in 1926 and Oranje-Nassau (Number IV) in 1927.

Alarm, however, was increasingly felt in Dutch political and industrial circles at the end of the nineteenth century that the country's mining enterprise had fallen so far into the hands of foreign interests, and it was considered desirable for the State to take a considerable measure of future responsibility. It was not intended that the foreign concessions should be expropriated, but that private and State mines should exist side by side.

[1] The maps and graphs used throughout this article are based on statistics supplied by the *Voorlichtingsdienst der Nederlandse Steenkolenmijnen.*

FIG. 3. The Emma Colliery, and FIG. 4, the Maurits Colliery. (Photographs supplied by and published by permission of the *Voorlichtingsdienst der Nederlandse Steenkolenmijnen.*)

The State, therefore, reserved to itself most of the remaining proven area by the Act of June 24th, 1901, and in 1912 it formally extended its domain over all the province, except for the areas already conceded to the private companies. A State company, the *Staatsmijnen in Limburg*, was formed, and the first coal was produced in 1906 by the Wilhelmina colliery, which was developed in the extreme southeast in the State "exclave" concession (Fig. 2). The palatial headquarters of the *Staatsmijnen* was established in Heerlen. Three other state collieries were built —Emma in 1911 (Fig. 3), Hendrik in 1915, and the great Maurits undertaking in 1923 (Fig. 4).

POSTWAR DEVELOPMENTS

When Limburg was liberated by allied troops in the autumn of 1944, the mines were idle as a result of the military operations. Apart from some material damage (although not of a serious nature), the chief handicap to development was a shortage of labor, partly because many miners had joined the allied armies, partly because of the aversion felt to mining as a result of German forced labor decrees. There was also a shortage of materials and mining equipment, and maintenance had been largely neglected during the later years of the war.

It was obvious that the restoration of the Limburg field to full production was of vital importance to the postwar recovery of the Netherlands. In order to systematize and integrate the coal-production drive, the whole coal field was put temporarily under State control by the Mine Statute of June, 1945, with a Custodian (or Chairman) appointed by the Queen, and an Organization of Joint Committees under the Minister for Economic Affairs. At the head of this Organization was placed the National Consultative Board. This proved to be so useful that when State control was ended at the beginning of 1949, and the private collieries regained full control, the Board was retained, with its offices at Heerlen. At present its membership is 20, of whom six are nominated by the State mines and four are appointed by the Boards of Directors of the private companies; of the remaining members, four represent the mining officials and six are nominated by the recognized Workers' Unions.

In addition to this Board, there are five Company Consultative Committees, one for the group of State mines and one for each of the four private companies. These bodies, too, have a wide representation, including nominees of the directors, the shareholders, the mining officials, and the workers. Finally, each colliery, coke oven, or other individual plant has its own Works Consultative Committee.

In the words of the Mine Statute, the policy of these various organizations is ". . . the promoting of the well-being of the country's economy in so far as this can be realized by the exploitation and utilization of coal and by the manufacture of by-products; the promoting of an economically and socially sound management policy; and the promoting of the social security of all workers employed in the mining industry." The success of the policy is shown by the fact that the labor force in the industry, which totalled 34,000 in May, 1945, had increased to 47,000 in 1950; while output rose from a little over 5 million tons in 1945 to 12.2 million tons in 1950, and still farther to 12.4 million tons in 1951. To put it another way, the average daily output has been stepped up from 14,423 tons in May, 1945, to about 34,000 tons in 1951.

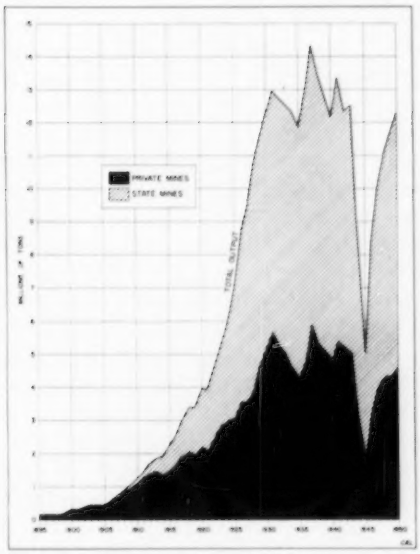


FIG. 5. Output of coal from private and State mines, 1895–1950.

OUTPUT OF COAL

The output of coal in Limburg since the opening of the field in 1895 is summarized graphically in Figure 5, which differentiates between the output of the State and the private mines. If this diagram is studied in conjunction with Figure 6, which expresses this relationship on a percentage basis, it will be seen that the later-developed State mines gradually increased their output, until in 1924 they produced exactly half of the total. Since 1926 they have been responsible for about 60 per cent, compared with the 4.5 million tons of the private mines (Fig. 7).

As already said, the 1950 output exceeded 12 million tons, and this recovery from the trough of 1945 represents a substantial achievement. The total is not, however, quite back to that of the years preceding the war; in 1937 and 1938, about 14.3 (the highest ever) and 13.5 million tons respectively were produced, and even during the German occupation in 1941 output exceeded 13 million tons.

The output of the individual collieries in 1950 is summarized on Figure 7. It can be seen that five of the private collieries each produced more or less half a million tons per annum; Oranje-Nassau (Nos. II and III) and Julia were responsible for about three-quarters of a million. The four State mines, however, are much larger producers, each considerably exceeding a million tons, while Maurits (with 2.8 million tons in 1950), is the biggest individual colliery in western Europe.

LABOR

The labor force in the Dutch mines rose from 34,000 in 1945 to 47,000 in 1950, as the result of an intensive recruiting campaign. Modern educational methods have been applied. Underground Vocational Training Schools (O.V.S.) have been established at each colliery, under the supervision of a State Board of Management. Boys selected to enter the industry follow a course of three years' duration, including general education, physical training,

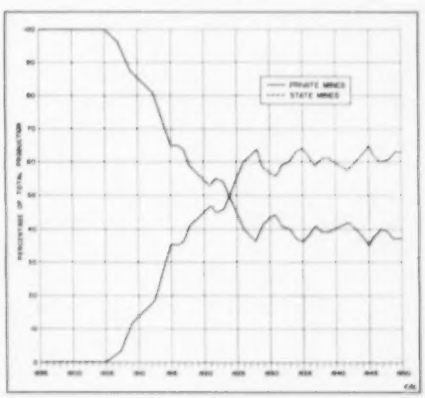


FIG. 6. Percentage production of private mines contrasted with that of State mines, 1895–1950.

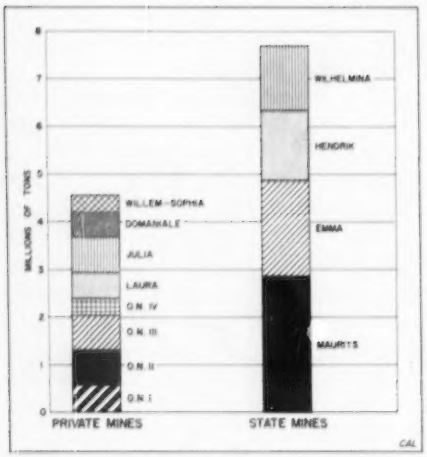


FIG. 7. Coal production of individual private mines and of State mines, 1950.

and character training, and of course the necessary technical instruction. The candidates are paid throughout these three years. One interesting feature is the "practice mine," a full-scale imitation mine, usually sunk in the waste-dumps beside the collieries. All candidates for employment in the State mines, both as underground and surface workers, are selected by the Psychological-Educational Service, a team of experts first set up in 1939. In addition to candidate selection, this Service advises on all matters of employment, discipline, welfare works, and public relations in general.

Since the Organization of Joint Committees was established, very comprehensive wage regulations have been drawn up, involving basic time and piece rates, based on a merit-rating classification. Additional bonuses are paid as child allowances, for long service, at Christmas, and for holidays; a family bonus is paid to each miner who lives with and maintains his family. Holidays with pay increase with the number of years of service.

Every miner becomes a member of the General Miners' Fund, the Board of Management of which consists of representatives of the employers and the workers. The Fund draws its contributions from both employers and employees, together with a substantial State grant, and provides sickness benefits and disability, retirement, and widows' pensions. The State mines also operate a Miners' Welfare Fund, to promote various social interests. This provides large co-operative shops and stores; it runs miners' hostels; it offers alternative work for miners who have been incapacitated for underground labor and also part-time work for female relatives; it subsidizes educational and recreational clubs; and it provides facilities such as holiday camps, swimming baths, and sports fields.

As in other countries, the building up of a labor force must result in housing needs. In Belgium, for example, this is met by the construction of housing estates by the colliery companies themselves. In the Netherlands the postwar building program has been put in the hands of two corporations, *Ons Limburg* and *Thuis Best*, on which are representatives of the Government, the mining companies, the workers, and the municipalities. These corporations draw up the building plans and supervise the construction by contractors; some 3000 permanent houses and several blocks of flats have been built since 1945. Rents are lower than the average for the rest of the country, since they are subsidized by the mining companies. Larger houses for the colliery administrative staff are built and owned by the companies themselves.

These various measures have helped to recruit and maintain a labor force of very high quality in the Dutch mining industry.

VALUE TO THE NETHERLANDS

The Netherlands is a highly developed industrial country. However, surrounded as it is by the heavy industrial areas of Belgium, Luxembourg, and western Germany, which can produce steel in great quantities, the Netherlands has concentrated on specialized, highly-fabricated, heavily-capitalized industries, distributed widely throughout the country. Many of these industries are based on colonial imports and agricultural products, others on "new" processes. The importance of the Netherlands' coal output, even though it is small compared with that of Germany, France, and Belgium, is that it is able to supply a considerable portion of the country's fuel needs. Figure 8 illustrates graphically the percentage contribution which the Limburg field has made of the country's consumption. Since 1945 it has supplied some 80 per cent, although it will be noticed that for several years before the war there was actually a slight surplus for export. It must be emphasized, however, that the increasing postwar industrialization of the Netherlands, coupled with the export drive and the rearmament contribution which the country must sustain in common with much of western Europe, will probably reduce the proportion that the Limburg field can contribute. Assuming that output is stabilized at about 13 million tons per annum, the Government estimates that by 1960 only 65 per cent of the country's needs can be met from within. This accounts for Dutch interest in and membership of the six countries' Coal and Steel Community, and especially their interest in the future of western Germany.

In 1950, Dutch coal imports totalled 4.3 million tons, of which 2.97 came from western Germany, 0.76 from Great Britain, and 0.47 from Belgium. On the other hand, in that year the Netherlands was able to export more than a million tons of high-grade metallurgical coke, of which 0.37 million tons went to Sweden, 0.32 to France, 0.20 to Belgo-Luxembourg, and 0.10 to Switzerland. The trend of coal imports and exports from 1895 to 1950 is indicated on Figure 9. Table I summarizes the disposal of the coal output of Limburg in 1950.[2]

TABLE I

DISPOSAL OF LIMBURG COAL OUTPUT, 1950

(Thousands of tons)

Coking-plant	3,203
Patent-fuel plant	986
Gas-works	147
Consumed at the mines	123
Thermal power-stations	2,467
(Excluding those at mines)	
Railways	577
Inland waterways	226
Bunker-coal	343
Industry	2,719
Domestic consumption	2,875

TRANSPORT

The Limburg field is situated, as it were, in a remote corner of the Netherlands, and therefore the transport of such bulky items as coal and coke demanded special organization, both by rail and water. The Limburg mines are served by a single-track standard-gauge line, operated by the Mines Railway Department with its headquarters at Heerlen. Each colliery has its own sidings, whereas the main marshalling yard is at Susteren in the north. The Mines Railway is linked to the State Railway at several points.

The Juliana Canal leaves the Meuse at Maastricht, runs northward for 21 miles parallel to the river (which here

[2] It will be appreciated, incidentally, that this list of consumption totals more than the output of 12.24 million tons of disposable coal. The reason is that some items must overlap; e.g., some of the coal consumed at the patent-fuel plant will be used in the form of briquettes by domestic and other consumers.

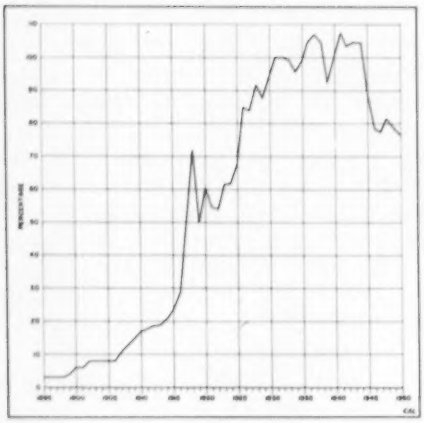


FIG. 8. Dutch coal production as a percentage of the total national consumption, 1895–1950.

forms the frontier between Belgium and the Netherlands), and rejoins the Meuse below Maasbracht. To a large extent, this waterway was mainly intended to serve the coal field; approximately two-thirds of the freight carried consists of coal and coke. The two ports of Stein and Born were built to handle coal from the State and private mines respectively; Stein has a capacity of 4½ million tons (Figs. 10 and 11), Born of 2 million tons.[3] Both are equipped with modern coal-handling facilities. Shipments of coal through the Stein port since it was opened in 1935 are shown in Table II. It is interesting to note that the port has not yet recovered its prewar importance.

COKE PRODUCTION

About a quarter of the Limburg coal is coked on the coal field, itself, in plants situated at the Emma and Maurits

TABLE II

SHIPMENT OF COAL THROUGH STEIN

(Millions of tons)

1935	2.40	1941	3.00	1947	1.79
1936	3.33	1942	2.51	1948	1.99
1937	3.52	1943	2.67	1949	2.20
1938	3.46	1944	1.84	1950	2.75
1939	3.35	1945	1.50		
1940	2.32	1946	1.81		

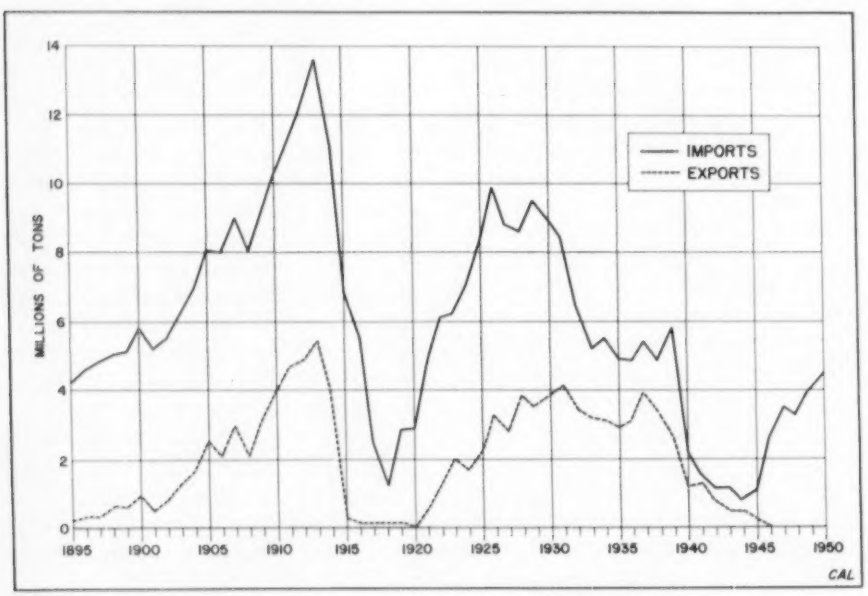


FIG. 9. Dutch coal imports and exports, 1895–1950.

mines. The former was built during 1916–1918, the latter in 1929, and subsequent additions of batteries of compound ovens have made the Maurits coking plant, with its 489 ovens, the biggest single unit in Europe. Modern crushing and screening plants were installed, and by 1939 the two plants had a daily capacity of 10,000 tons, of which the Maurits plant produced two-thirds.

After the liberation in September, 1944, other demands on coal output meant that both plants could not be kept in operation. The Emma plant was put out of production between 1944 and 1948, and daily coke production dropped to about 6000 tons. In 1948, the Emma plant resumed operation, bringing production up to 7500 tons per day, and a new battery of ovens was opened at the Maurits plant in August, 1949. As a result, the total coke output for 1950 attained 2.2 million tons, approximately two-thirds of that of the 1936–1938 figure; increased demands in other directions meant that less coal could be allocated to coke production.

The Emma plant has now been in operation for nearly 40 years, and plans are in an advanced stage for renewal of the batteries. In addition, an entirely new plant (the coke plant Emma II) is under construction at Beek.

The fine coking quality of some grades of Limburg coal, which produce coke of high crushing strength and low phosphorus and sulphur content, has given Dutch coke a considerable international reputation, and, as we have seen, more than a million tons, or about half the output, is exported.

GAS PRODUCTION

In the process of coke manufacture, large quantities of gas are produced, although about half of it is used to heat the coke ovens themselves. About a quarter of the gas derived from the Maurits and Emma ovens is put into a high-pressure gas grid of 120 miles length, which, with 17 distribution stations, links the ovens with domestic and industrial consumers throughout the provinces of Limburg and North Brabant. It extends to Nymegen in the north and to Bergen-op-Zoom in the west. Moreover, the grid is connected by gas main with the Ruhr, by way of Alsdorf, and Germany is supplying considerable quantities of gas to the Netherlands. A link with the Belgian gas grid in the Sambre valley industrial area is projected, as part of the integration of the industries of western Europe. It is interesting to note that the largest gas holder in Europe was situated at the Maurits coke ovens, but this was destroyed by allied air action during the war.

BY-PRODUCTS

One of the biggest industrial units in the Netherlands is the Nitrogen Fixation Plant built in 1930 at Geleen near the Maurits colliery, and owned by the State Mines Company. An additional fixation plant was installed in 1949. Pure hydrogen is extracted from the coke-oven gas (a quarter of the total production is used in this way). Nitrogen is obtained by compressing air at a very low temperature so that it is liquefied, and then isolating the nitrogen and oxygen by fractional distillation. The nitrogen and hydrogen are mixed, compressed, and, after various processes, liquid ammonia is produced. Other by-products of the fractional distillation process, such as carbon dioxide and ethylene, are also utilized. A wide range of products is made at various sections of the works; ammonium sulphate, calcium nitrate, sodium nitrate, and other nitrogenous

FIGS. 10 (left) and 11 (right), views of the State mines' coal port on the Juliana Canal, at Stein. (Photographs supplied by and published by permission of the *Voorlichtingsdienst der Nederlandse Steenkolenmijnen.*)

fertilizers totalled half a million tons in 1950. Nitric acid, alcohol, cleaning agents, detergents and solvents, phenol, and many more vital industrial commodities are manufactured. In addition, a tar distillation plant produces tar oils, naphthalene, and pitch (which is used as a binding material in the briquette and ovoid plant). The close liaison between the collieries, coke ovens, and coke-oven plant, all owned by the State Mines Company, is a striking feature of the industrial scene in Limburg.

ELECTRICITY

Power stations have been erected at the State-owned Maurits, Emma, and Wilhelmina mines, and at the privately-owned Oranje-Nassau, Julia, and Domaniale mines. In 1950 a new station was put in operation at the Nitrogen Fixation Works. The Maurits power station has an installed capacity of 154,000Kwh. These stations not only supply the collieries with the large amount of power they require, but also the two coke plants and the Nitrogen Fixation Plant. About a quarter of the generated energy, surplus to the collieries' own requirements, is supplied to private consumers through the P.L.E.M. (Provincial Limburg Electricity Company), and an electricity grid has been built throughout Limburg. Before the war, this Limburg grid was isolated from that of the rest of the Netherlands, but in 1941 a connecting line between Roermond and Eindhoven united the Limburg and North Brabant grids. Although partly destroyed in 1941, it was repaired in 1945, and since that year the Limburg grid has been connected with the provinces of South and North Holland. In brief, a country-wide grid has been built up, to which the Limburg colliery power stations can contribute. As with the case of the gas grid, considerable progress has been made with the development of international links. Before 1939, Maastricht and Liège were connected, and during the war the Germans built a high-voltage transmission line from the German network at Aachen across Limburg to Liège. At the end of the

war this line was connected to the Maurits power station.

CONCLUSION

It is abundantly clear that the coal field of South Limburg makes a substantial contribution to the economic life of the Netherlands. Not only does it provide some four-fifths of the country's fuel needs, obtained efficiently by large modern units, but it also produces high-grade metallurgical coke, a wide range of chemical by-products, coke-oven gas, and thermal electricity; the two last benefit not only Limburg itself, but are distributed to consumers further afield. Only one province, Overyssel, has a higher proportion of its occupied population engaged in industry—some 48 per cent, compared with 45 per cent in Limburg. Yet the industrial centers are concentrated, so that whereas Limburg can be called an "industrialized region," it is still for the most part a pleasant agricultural province, with dairy farms, arable farms growing sugar beet and maize, and extensive orchards.

ACKNOWLEDGMENTS

The writer wishes to acknowledge gratefully his indebtedness to Mr. S. J. M. Bekman of the *Voorlichtingsdienst der Nederlandse Steenkolenmijnen*, who besides acting as his host and guide in Limburg, supplied him with much statistical and other information.

THE PURPOSE AND SOURCE OF SEASONAL MIGRATION TO ALASKA

William J. Stanton

Mr. Stanton is Associate Professor of Marketing at the University of Washington. He was in charge of a study of the economic aspects of Alaska's recreation resources, which was carried on by the University's Bureau of Business Research under contract with the National Park Service.

THE economy of Alaska is subject to extreme seasonal fluctuations and, in fact, has been ever since the first recorded settlement by white men. The basic reasons for these ups and downs in the territorial economy are the climate and the nature of the major Alaskan industries. The winter climate—very cold in the interior and very wet in the coastal regions—discourages outdoor activities such as construction, mining, and the tourist industry, three bulwarks of the economy at the present time.

Historically, the Alaskan economy has been based primarily upon the export of three raw materials or natural resources—fish (mainly salmon), minerals (mainly gold), and furs. Two of these—fish and furs—are the products of seasonal activities.

It is true that seasonal forces affect the situation less severely today than in years gone by. Attempts to lengthen the working season for some industries (such as construction) by better planning, newer processes, and other factors have met with some success. However, a high peak period for virtually every Alaska business and industry occurs during the summer months—and such will continue for years to come.

This seasonality places much strain on the transportation facilities and the labor supply. Airlines add many flights during the summer, and the highway traffic increases materially. Steamship companies serving Alaska use all available passenger ships (more than half of which lie idle all winter because of slack demand), and even then reservation lists are filled three to six months before sailing dates.

During the decade of 1940–1950 Alaska experienced a population growth of 77 per cent (72,542 in 1939 to 128,643 in 1950), the largest increase percentagewise of any state or territory under the American flag. In spite of such growth, the territory still imports a considerable proportion of its summer labor supply. In addition, tourists account for a large part of the seasonal influx.

Many territorial businessmen are aware of the economic value of the visitor who comes to work during the summer, and to a lesser extent they realize the potential value of the tourist. As a result there is a growing desire among Alaskans to know more about the seasonal visitor, tourist and otherwise, so that they may encourage his coming and plan for it. Specifically, they must know how many people visit Alaska during the summer, why they come, and from where they come.

Survey Method

The purpose of this article is to report on and discuss some of the economic

TABLE I

SOME PERCENTAGE RELATIONSHIPS SHOWING SEASONALITY OF MIGRATION TO ALASKA. (BASED UPON ROUTE OF SOUTHBOUND TRAVEL USED, JUNE 1, 1952–MAY 31, 1953)

Southbound Route of Travel	*Per Cent of Total Passengers That Were Visitors, June–September*	*Per Cent of Total Passengers That Were Visitors, October–May*	*Of Annual Total of Visitors, Per Cent That Came Between June 1–September 30*
Air	74	40	67
Sea	98	40	89
Highway	84	67	64
All routes combined	80	45	71

geographical patterns that emerged from a study of migration to Alaska during the summer of 1952. Data are from a questionnaire survey of *southbound* passengers who departed from the territory between June 1 and September 30, 1952.[1] Questionnaires were distributed and collected by all four steamship lines and the five major airlines (one non-scheduled) with passenger service to Alaska and the United States Customs and Immigration station on the Alaska Highway at Tok Junction, Alaska. The study covered a sample of 44 per cent of all people leaving Alaska within the four-month period. The sample findings were adjusted for proportionality based on route of southbound travel—be it air, sea, or highway—and then expanded to reflect total travel.

The survey was continued during the "off-season" of travel from October, 1952, through May, 1953, using the same basic method as during the summer but on a more limited scale. The purpose was to round out the coverage of 12 consecutive months in order to ascertain more clearly and definitely the seasonal patterns of migration that exist.

In the analysis and interpretation of questionnaire returns the Alaskan residents were separated from the visitors, and most of the statements that follow in this paper pertain only to the latter group.

AMOUNT OF SEASONAL MIGRATION

The extreme nature of the seasonal migration to the territory is summarized in Table I by route of southbound travel used during the year ending May 31, 1953. During the four summer months 80 per cent of the travelers were visitors,[2] while during the eight-month fall, winter, and spring period (October through May) only 45 per cent of the passengers were visitors. Stated another way, almost three-fourths (71 per cent) of all visitors who came to Alaska within one year came between June 1 and September 30.

The seasonal travel pattern for the Alaska residents is just opposite to that of the visitors. The residents do most of their traveling to and from the territory during seasons other than summer. The reason the residents stay at home in the summer is interrelated with the reason for the influx of visitors during

[1] The questionnaire study was a part of a broad-scale recreation survey of Alaska initiated by the National Park Service in 1950 for the purpose of developing a long-range plan to provide guidance for Federal and Territorial agencies, organizations, and individuals in (1) the protection of Alaska's recreation resources, (2) the development of its park and recreation facilities, and (3) the expansion of its tourist facilities. One part of the broad project—the study of the present and potential *economic* aspects of Alaska's recreation resources—was done by the Bureau of Business Research, University of Washington, under contract with the National Park Service.

[2] During July and August, the peak months of travel, about 90 per cent of all passengers were visitors; only 10 per cent were residents of Alaska.

the same interval. June through September is the peak period for virtually every business activity in the territory. So the residents remain in Alaska to tend to this business. Then during the "off-seasons," the time when business is relatively slack (and incidentally the time when climatic conditions are more favorable elsewhere), there is some seasonal exodus of Alaskan residents.

That there were significant differences in seasonal patterns, depending upon the route of travel used, is also evident from Table I. By far the greatest degree of seasonal fluctuation existed in steamship travel. The combination of circumstances leading to the fact that practically all (98 per cent) of the southbound steamship passengers during the summer are visitors is as follows: (1) there is a shortage of passenger ships in relation to demand; (2) because of the shortage of berths, visitor reservations are made far in advance; (3) Alaska residents who do want to go "outside" during the summer ordinarily do not plan a date months in advance. Therefore, when they are ready to leave, no space is available; (4) Canadian ships operating only during the summer season cater to tourists and make little or no effort to carry Alaska residents.

Almost all (89 per cent) of the annual total of visitors traveling by steamship made the trip in the summer. This is because the summer season is the big tourist season in Alaska and most ship's passengers are tourists (and most tourists go by ship).[3] On the other hand, the highway route tells a different story. There the majority of passengers all year round are visitors, 84 per cent in the summer and 67 per cent during the remainder of the year. The ratio of visitors to total traffic during the October-May period remained relatively high for motorists as compared to air and sea passengers, probably because road conditions are more conducive to travel during the colder months than during summer. There is less, in the way of rocks, bumps, and dust to contend with when the roads are frozen and covered with hard-packed snow.

In actual numbers, over 52,000 people visited Alaska between June 1 and September 30, 1952. Fifty-two thousand may not seem like very many until one compares the figure with Alaska's total population of about 130,000. When it is realized that the number of summer visitors equals about 40 per cent of the resident population, then the importance of the seasonal influx may become more evident.

PURPOSE OF VISITOR'S TRIP

The major reason people went to Alaska during the summer months was for a vacation only, 20,252, or 38.9 per cent, so reporting (Table II). Almost 15,000 (28.6 per cent) traveled for business reasons only, the second ranking

TABLE II

PURPOSE OF VISITOR'S TRIP TO ALASKA, JUNE 1–SEPTEMBER 30, 1952*

Purpose of Trip	*Visitors*	
	Number	*Per Cent*
Vacation only	20,252	38.9
Business only	14,901	28.6
Business and vacation	5,742	11.0
Visit family	4,915	9.4
Military	4,342	8.3
Government	1,595	3.1
Other	356	.7
Total	52,103	100.0

*Period of time during which the visitors departed from Alaska.

[3] In fact, steamships outbound from Alaska carried over three times as many passengers (residents and visitors) from June through September as they carried during the other eight months combined (13,000 to 4,000).

purpose of visitors' trips.[4] The relatively large number of tourist visitors should make some people in Alaska take notice. Many residents recognize that visitors on business are a valuable seasonal stimulant to the territorial economy. Yet here is another group—the tourists—that in numbers at least are of even greater importance.[5] Two recognized qualifications need to be made at this point. First, the per capita expenditures made *in Alaska* by businessmen are probably greater than those made by tourists. Second, many visiting business workers, taking advantage of the lengthened season in some industries referred to earlier, did not leave Alaska until after September 30, the closing date of the summer survey.

Another factor contributing to the extremely seasonal nature of the Alaskan economy is that over 95 per cent of the total annual number of tourists visit the territory sometime during the four-month period of June-September.

The ranking numerical importance of the tourist visitors has at least two implications in the Alaskan economy. First is the fact that the vacationing traveler takes very little in the way of tangible goods from the territory. He leaves dollars and, except for souvenirs, he takes nothing but pleasant memories of natural scenery and other tourist attractions, in contrast to the fisherman, the miner, and the trapper who have removed natural resources at a greater than replaceable rate.

The second implication concerns the future. People with an interest and concern in Alaska recognize that much of its economy is based upon government expenditures, particularly for defense. They wonder what is going to happen, what will take up the slack, when defense construction declines considerably. Some of these people are looking with interest at the potential in the tourist industry and at the large influx of seasonal visitors who come to the territory only for vacation purposes. Already some cities, particularly in southeastern Alaska where defense construction activity is not nearly as important as around Anchorage and Fairbanks, have far more summer visitors who are on a vacation only than who have come for any other purpose. Some Alaskans are fully aware that today in some other regions the tourist industry is as important as manufacturing, extractive industries, or agriculture. While the Alaska tourist industry has many needs and a long way to go in some cases to compete for and to attract additional vacationers, the already existing patterns of seasonal migration do point up the potential value of the industry to the territory.

The second largest group of visitors classified by purpose of trip were those who went to Alaska on "business only," 14,901 or 28.6 per cent of the total being included in this category. The specific types of business that occasioned the trip were primarily fishing and construction. A small percentage of busi-

[4] The percentage distribution of visitors by purpose of trip was considerably different during the off-season of October through May. Of the reduced number of visitors during this period (26 per cent of the annual total—see Table 1) about 50 per cent went for business reasons only and but 5 per cent went for vacation only.

[5] As large as the tourist loomed in the total Alaska travel picture in the summer of 1952, a major steamship strike kept him from being even more important. Sailings of the Alaska Steamship Company vessels (leaving Seattle for Alaska) were cancelled because of a strike from May 30 until July 16, 1952. In addition, one sailing was cancelled because of an accident involving one of the ships. So altogether about 2800 passengers were lost by the one company. Company officials and travel bureau representatives estimate that approximately 10 per cent of the passengers were shifted to other carriers. The net loss in Alaska travel was roughly 2500 passengers, of which virtually 100 per cent were tourists. The 2500 "lost passengers" were equal to about one-eighth of those who went to Alaska for "vacation only," so part of the impact of the strike becomes apparent.

ness visitors were engaged in mining or marketing, but no other single industry was noted frequently enough even to list in a tabulation. Sixty per cent of the annual number of visitors on business left Alaska within the four-month summer period.

A combination of business and vacation was the reason given for the trip by more than 5700 (11.0 per cent) of the visitors. Apparently many of these people either worked in Alaska during the summer and took a vacation before returning to the United States, or they went to Alaska with the intention of coupling work and play in order to ease the financial strain of the trip.

The fourth-ranking group, those who went to visit their families, accounted for over 4900 or about 10 per cent of the visitors. In many respects most of these travelers probably could just as well have been included with vacationers, because they took their annual vacation time to make the trip. However, to avoid any risk of over-stating the tourist figure, a separate reason for making the trip was set up in tabulating. It was recognized that although these people did go to Alaska during their vacation period, they would not have done so if their families had not been there. Something other than the usual tourist attractions caused them to select Alaska as their destination.

Except for the military personnel and their families, no other group classified by purpose of trip included a significant number of summer visitors.

VISITOR'S EXPENDITURES

To set forth in some detail only the *number* of seasonal visitors, even though various cross-classifications and other relationships may be shown, is to present only a partial picture of the seasonal impact of the visitor industry on the Alaskan economy. Of additional interest would be various *dollar* measures of the value of the visitor industry to the territory. However, information is scanty concerning the expenditures of visitors directly in Alaska. The research upon which this paper is based did unearth detailed expenditure patterns for the visitors who went to Alaska for a vacation only. During the summer of 1952 tourists made an outlay of over $6.3 million for expenses incurred in connection with the Alaska part of their vacation. About three-fourths of this total was for transportation. Most of the transportation expenses were for airline or steamship fares between Seattle, Washington, or Vancouver, British Columbia, and Alaska; only a small portion of the total transportation expenditures was for intra-Alaska travel. Admittedly the figure of $6.3 million is a conservative estimate for the tourist business, because it does not include vacation expenditures made by people who went to the territory for a combination of business and vacation or for a family visit. Regardless of the conservativeness of the estimate, it is undoubtedly true that Alaska tourist expenditures at the present time fall far short of approximating those in most states.[6]

When all visitors are included, particularly those traveling on business only, the figures on visitor spending would of course be increased considerably.[7] In the survey period even though more visitors were tourists than were seasonal workers (Table II), the average length of stay was much longer for the workers. Therefore, the total number

[6] For example, tourist expenditures for 1952 in the state of Washington were about $135 million according to the latest report published by the Bureau of Economic Research at Washington State College.

[7] A careful estimate of expenditures made in Alaska by seasonal workers could be the basis of a worth-while research project.

of visitor-days was much greater for those on business only than for those on vacation only. Furthermore, the average daily expenditure in Alaska is higher for the workers than for tourists mainly because so many tourists go by steamship and therefore spend very little for food and lodging in Alaska.

Even recognizing that expenditures by all visitors would greatly swell the $6.3 million spent by tourists, it is doubtful if all Alaska visitors spend directly in the territory anywhere near the $29 million that is spent directly in Hawaii by visitors to that territory.[8]

HOME RESIDENCE OF VISITORS

Turning to a study of the source (home residence) of the visitors, some very definite patterns were uncovered in the survey. A street or mailing address was secured from over 99 per cent of the visitors who filled out questionnaires, so it was possible to analyze origins by state and Canadian province as well as by broader geographic areas.

Over 96 per cent of the visitors to Alaska in the summer of 1952 came from the United States and Hawaii; 3.5 per cent were from Canada and only .36 per cent came from other foreign countries. Although people actually came from every state in the United States and every province except one in Canada (Prince Edward Island in the Maritime Provinces), they were really concentrated from two states—Washington and California. These two accounted for over 49 per cent of the total visitors—almost as much as the rest of the world combined—with Washington furnishing a slightly larger percentage (24.97 per cent to 24.05 per cent). Each of the two was the source of more than four times as many visitors as any other one state. In fact, except for Oregon (5.9 per cent) no other state provided more than 3.5 per cent of the total visitors.

California was by far the most prolific source of tourists—30 per cent of the people on "vacation only" coming from the Golden State, whereas less than 10 per cent came from Washington. (However, the 10 per cent was still enough to put Washington in second place as a source of tourists.) Among the "business only" visitors, Washington furnished almost one-half (47 per cent) and California one-fifth. Together those two states accounted for more than two-thirds of all passengers traveling for reasons of "business only."

In Tables III and IV the home residence of the visitors is expressed in terms of geographic regions. Information is also presented for each of the three Pacific Coast states because of the importance of the region as a source of visitors to Alaska. The states are grouped into the nine standard regions used by the Bureau of the Census. Canadian provinces and territories are divided arbitrarily into three regions—western, prairie, and eastern.

From a regional standpoint the Pacific Coast easily led, because of course it includes Washington and California. Fifty-five per cent of the visitors came from the Pacific Coast; the second-place region, East North Central, furnished only 9.9 per cent (Fig. 1). In fact, there is no standout source other than the Pacific Coast, the remaining regions differing one from another by about 1 per cent or less. The poorest sources were New England and the South. The combined regions of New England, South Atlantic, and East South Central provided only 6 per cent of the visitors.

There were regional differences in the source of summer migrants to Alaska depending upon the purpose of the trip

[8] Hawaii Visitors Bureau, Research Committee, "The Impact of Visitor Dollars in Hawaii," 1953, p. 5.

to the territory (Table III). The Pacific Coast dominated as a source of those going for "business only," accounting for more than 12 times as many such visitors as the next most important region. (Seventy-six and one-half per cent came from the Pacific Coast as against only 6.0 per cent from the West North Central region.) While still the major source of visitors in the "vacation only" and "other" categories, the Pacific Coast was relatively less important in these two groups than in the remaining classifications, furnishing but 44 per cent of the tourists and 33 per cent of the passengers going for miscellaneous reasons.

The East North Central states supplied almost twice as many vacationing passengers as any other one region except for the Pacific Coast. However, in no other category by purpose of trip was there a standout area besides the Pacific Coast.

Almost one-half of the Canadian visitors were from the province of British Columbia. About 79 per cent of all Canadian passengers went to Alaska for a vacation only, but because the number of Canadians was relatively small, they accounted for only 7 per cent of the total tourist visitors.

From Table IV one may determine percentage-wise the reasons people *within* a region made the trip. For example, 30.9 per cent of the visitors from the Pacific Coast went for vacation only and 39.7 per cent went for business only. In the East North Central group 59.1 per cent went only for a vacation, but just 7.3 per cent had business as the sole reason for making the trip.

TABLE III

PURPOSE OF TRIP OF VISITORS TO ALASKA, JUNE 1–SEPTEMBER 30, 1952*, BY HOME RESIDENCE (GEOGRAPHIC REGION)

Home Residence	*Purpose of Trip*											
	Vacation Only		*Business Only*		*Business and Vacation*		*Visit Family*		*Other*		*Total*	
	Number	*%*	*Number*	*%*	*Number*	*%*	*Number*	*%*	*Number*	*%*	*Number*	*%*
Total	20,252	100.0	14,901	100.0	5,742	100.0	4,915	100.0	6,293	100.0	52,103	100.0
United States	18,731	92.5	14,602	98.0	5,703	99.3	4,799	97.6	6,260	99.5	50,095	96.1
Pacific Coast*	8,872	43.9	11,401	76.5	3,403	59.2	2,918	59.4	2,096	33.4	28,690	55.0
California	6,060	30.0	3,090	20.7	1,459	25.4	1,011	20.6	911	14.5	12,531	24.1
Washington	1,937	9.6	7,061	47.4	1,549	15.5	1,534	31.2	929	14.8	13,010	25.0
Oregon	832	4.1	1,234	8.3	387	6.7	373	7.6	252	4.0	3,078	5.9
East North Central	3,058	15.1	377	2.5	464	8.1	370	7.5	899	14.3	5,168	9.9
West North Central	1,584	7.8	886	6.0	531	9.2	525	10.7	724	11.5	4,250	8.2
Rocky Mountain	1,587	7.8	847	5.7	512	8.9	414	8.4	405	6.4	3,765	7.2
Middle Atlantic	1,511	7.5	374	2.5	231	4.0	121	2.5	554	8.8	2,791	5.4
West South Central	856	4.2	338	2.3	292	5.1	251	5.1	454	7.2	2,191	4.2
South Atlantic	653	3.2	169	1.1	119	2.1	105	2.1	671	10.7	1,717	3.3
New England	403	2.0	124	.8	107	1.9	55	1.1	216	3.4	905	1.7
East South Central	207	1.0	86	.6	44	.8	40	.8	241	3.8	618	1.2
Canada	1,431	7.1	250	1.7	33	.6	88	1.8	18	.3	1,820	3.5
Western	688	3.5	184	1.3	32	.6	8	.2	10	.2	922	1.8
Prairie	372	1.8	33	.2	1	0	..	..	..	..	406	.8
Eastern	371	1.8	33	.2	..	..	80	1.6	8	.1	492	.9
All other countries	90	.4	49	.3	6	.1	28	.6	15	.2	188	.4

*Period of time during which all visitors covered in the survey departed from Alaska.
•Pacific Coast region includes Hawaii so the figures for the three states do not add up to the regional total.

It is interesting to contemplate some possible reasons for, and conclusions to be drawn from, the geographical patterns uncovered in Tables III and IV, particularly the former. Why is there such a preponderance of seasonal visitors from Washington and California? Is there any significant correlation among the number of visitors from various regions, the population of these regions, and their distances from Alaska? Or are there other, less objective factors than population and distance that account in major part for the patterns that exist?

WHY TWO STATES MAIN SOURCE

The reasons so many Alaska visitors come from Washington are not unknown to anyone who is acquainted in some detail with the economic history of Alaska since its purchase by the United States in 1867, or, better yet, since the time (around 1900) of the gold rush into the Yukon Territory and onto the beaches at Nome. One is not so likely to be surprised by the fact that almost one-half (47 per cent) of all summer visitors on "business only" came from the one state when he understands that there have long been close associations in many lines of business between Alaska and Washington (Seattle, in particular). For example, the majority of ocean and air-borne supplies for Alaska has always funneled through the port of Seattle. Seattle wholesale houses usually include Alaska in their market, and some maintain branch offices there. The territory's largest retailing institution, the Northern Commercial Company, has its headquarters in Seattle. Manufacturers frequently include Alaska as part of the Pacific Northwest region when granting exclusive territorial franchises to Seattle-based wholesalers. Most of the Alaska fishing fleet sails from Washington ports, and its catch is usually processed either in Washington or in an Alaskan cannery owned by Washingtonians. In either case the fish

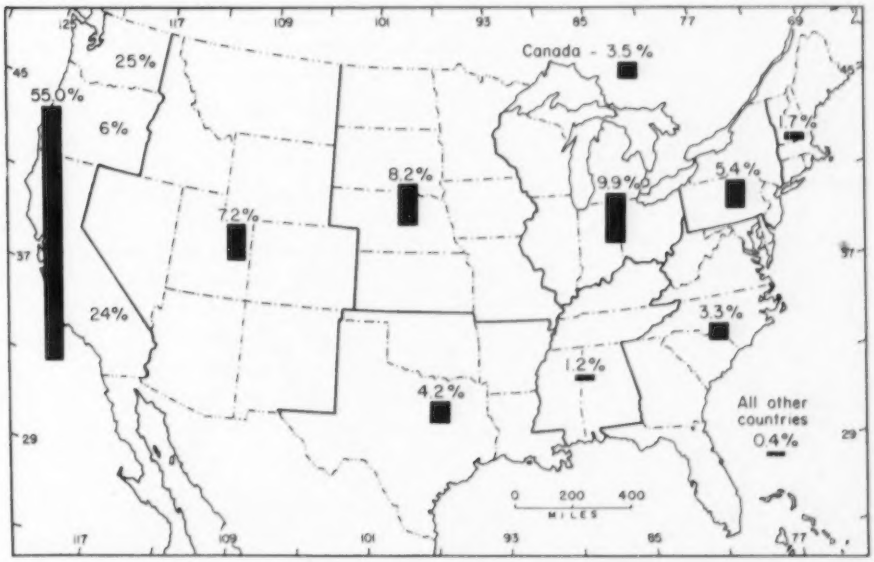


FIG. 1. Home residence of visitors to Alaska, June 1-Sept. 30, 1952. (Source: Table III.)

TABLE IV

HOME RESIDENCE (GEOGRAPHIC REGION) OF ALASKA VISITORS, SOUTHBOUND JUNE 1–SEPTEMBER 30, 1952, PERCENTAGE BY PURPOSE OF TRIP

Home Residence	*Purpose of Trip*					
	Total Per Cent	*Vacation Only*	*Business Only*	*Business and Vacation*	*Visit Family*	*Other*
Total	100.0	38.9	28.6	11.0	9.4	12.1
United States	100.0	37.5	29.1	11.4	9.5	12.5
Pacific Coast	100.0	30.9	39.7	11.9	10.2	7.3
California	100.0	48.4	24.7	11.6	8.1	7.2
Washington	100.0	14.9	54.3	11.9	11.8	7.1
Oregon	100.0	27.0	40.1	12.6	12.1	8.2
East North Central	100.0	59.1	7.3	9.0	7.2	17.4
West North Central	100.0	37.3	20.8	12.5	12.4	17.0
Rocky Mountain	100.0	42.2	22.5	13.6	10.9	10.8
Middle Atlantic	100.0	54.1	13.4	8.3	4.3	19.9
West South Central	100.0	39.1	15.4	13.3	11.5	20.7
South Atlantic	100.0	38.1	9.8	6.9	6.1	39.1
New England	100.0	44.5	13.7	11.8	6.1	23.9
East South Central	100.0	33.5	13.9	7.1	6.5	39.0
Canada	100.0	78.7	13.7	1.8	4.8	1.0
Western	100.0	74.5	19.9	3.5	1.0	1.1
Prairie	100.0	91.9	8.1	.....	.....	.....
Eastern	100.0	75.4	6.7	.....	16.3	1.6
All other countries	100.0	47.8	26.1	3.2	14.9	8.0

are probably marketed through Washington middlemen.

Also, there are close family ties between Washington and the territory as evidenced by the fact that of all the people going to Alaska to visit their families, 31 per cent were from the Evergreen State.

Concerning California, if we knew definitely why so many Alaska visitors on "vacation only" come from that state, we could explain in large part why it furnished an inordinately large number of the total visitors. Almost one-half (48 per cent) of all those from California were tourists and they in turn accounted for 30 per cent of all tourists (visitors on "vacation only"). It is true that distances to Alaska from points in California are shorter than is the case from most other parts of the country, and the state's population is relatively large. This is not the full story, however, as witness the fact that California furnished but 21 per cent of visitors on "business only" or "visiting family" and only 14 per cent of those going for miscellaneous purposes. Additional reasons so many tourists came from California must stem from factors that are less objective than population and distance.

In the realm of conjecture, one idea advanced concerns the number of alternative destinations open to the tourist. If a Californian wishes to go out of state for his annual summer vacation, one great tourist destination, California, obviously is eliminated. Therefore, Alaska has a better opportunity to attract him than to attract a person from some other state.

Another possible reason is that Californians, stimulated by a climate that encourages informal outdoor living, tend to travel or to be on the move more than people from other regions of the

TABLE V

SOME RELATIONSHIPS BETWEEN (A) REGIONAL RESIDENCE, ALASKA VISITORS, JUNE–SEPTEMBER, 1952, AND (B) COMBINATION OF (1) REGIONAL POPULATION AND (2) DISTANCE FROM SEATTLE.*
(PACIFIC COAST REGION IS EXCLUDED)

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
						Alaska Visitors	
Region	*Regional Center*	*Distance: Reg. Center-Seattle (00) miles*	*1950 Population (millions)*	*Pop. ÷ Distance (P/d)*	*Per Cent of Total P/d*	*Per Cent Total Regions*	*Number (000)*
New England	Boston, Mass.	31	9.3	.30	5	4	.9
Middle Atlantic	New York, N. Y.	30	30.2	1.01	17	13	2.8
South Atlantic	Columbia, S. C.	29	21.2	.73	12	8	1.7
East North Central	South Bend, Ind.	22	30.4	1.38	24	24	5.2
East South Central	midway between Birmingham-Nashville	26	11.5	.44	8	3	.7
West North Central	Sioux City, Iowa	18	14.1	.78	13	20	4.3
West South Central	Dallas, Texas	22	14.5	.66	11	10	2.2
Mountain	Salt Lake City, Utah.	9	5.1	.57	10	18	3.8
Total		—	—	5.87	100%	100%	21.6

*Seattle is the major airport and seaport of embarkation for Alaska

country.[9] The fact that the state has the highest per capita automobile registration among all states might attest to the point that the "wanderlust" affects Californians more than is true of others.

P/D RELATIONSHIPS

Except for the Pacific Coast where the number of visitors is disproportionately large in relation to its population and distance from Alaska, there seems to be a significant degree of correlation between (1) the number of visitors a region sent to Alaska and (2) the combination of (a) the population total of the region and (b) the distance it is from Alaska (or the embarkation ports of Seattle and Vancouver, British Columbia). This is another example of the well-known P/d relationship as shown by Stewart, Zipf, Dodd, and others for other phenomena. Some of these relationships appear in Table V where columns (f) and (g) are the significant ones.[10] In three regions—New England, East North Central and West South Central—the degree of correlation seems amazingly high. Variations from the P/d relationship, however, appear to indicate that distance is slightly more of a factor than the simple P/d relationship shows. Note that the two regions (West North Central and Mountain) that furnish *more* than their P/d share of visitors are both *west* of the Mississippi River, while the three regions (Middle Atlantic, South Atlantic and East South Central) that send *less* than their proportionate share are all *east* of the river.[11]

As a concluding note, while the formal survey covered the summer seasonal influx of visitors during one year only, June, 1952, to May, 1953, the writer has no reason to believe that the patterns unearthed are not typical of those

[9] In answer to the question of why so many Alaska tourists come from California, more than one travel authority has told the author "it is just that they (Californians) have to be going somewhere; they have 'itchy feet'."

[10] Only general calculations were made. There was no attempt to ascertain the mathematically exact coefficient of correlation by determining the geographical center of population for each region, combining it with the population and then correlating with the number of visitors.

[11] Remember in this case a region's "proportionate share" is based on its population and distance from Seattle.

for other recent years. In fact, for over a full year prior to the summer of 1952 and also since that summer, an informal but extensive and careful investigation was conducted among businessmen in many fields in Alaska—transportation, construction, fishing, government, wholesaling, and the tourist industry, to mention a few. As a result, no significant changes in the migration patterns over the past few years were found.

THE ZANDE SCHEME IN THE ANGLO-EGYPTIAN SUDAN

William A. Hance

Dr. Hance, Associate Professor of Economic Geography in the Graduate School of Business, Columbia University, made a reconnaissance trip to the Sudan and other countries of Central Africa under the auspices of the Carnegie Corporation in late 1952. A product of this field work, "The Gezira: An Example in Development," appeared in the April, 1954, issue of the Geographical Review.

EQUATORIA Province in the Southern Sudan is the scene of an interesting and little publicized development scheme designed as an experiment in raising the social and economic level of an African peoples in an isolated area (Fig. 1). The Zande Scheme is situated in the southwest corner of Equatoria Province between Tambura and Maridi (Fig. 2). The village of Yambio, headquarters of the Zande district, is the administrative center for the scheme, and Nzara, 15 miles to the northwest, is the site of the industrial portion of the operation. Nzara is 350 miles west of Juba on the Nile, to which it is connected by trunk road, 1500 miles from Khartoum, and 2000 miles from Port Sudan.

The Zande district includes some 21,345 square miles of rolling plateau country near the Congo-Nile watershed.[1] The many streams and rivers that cross the area are fringed by gallery forests; between them is high grass with numerous medium-height trees scattered throughout. Average precipitation is over 40 inches a year falling in an eight or nine month period. Soils are laterized, of low intrinsic fertility, and susceptible to erosion. They vary, however, from deep red loams of good water holding capacity to light shallow soils full of ironstone pebbles and of poor water-holding capacity.[2]

The area is inhabited by 180,000 to 200,000 pagan Azande, a tribe whose members are also found for a considerable distance westward in the Belgian Congo and French Equatorial Africa. They are accustomed to pra ing a shifting agriculture with a grea riety of crops including corn, eleusine (finger millet), cassava, pineapples, papaya, bananas, peanuts, and mangoes. Sleeping sickness was formerly a great human scourge and continues to preclude cattle except under strictly controlled conditions. The desire for proteins is partially satisfied by hunting, by eating rodents, and by making a rich food oil from termites which are collected by attracting them with flaming torches, which burn their wings.[3] Although relatively untouched, the Azande were selected for this experiment because they were considered sufficiently industrious and amenable to organization.

Purpose and Organization of the Scheme

The area of the Zande Scheme was deliberately selected because of its

[1] Equatoria Province Handbook, Vol. 1, Sudan Government Memoranda No. 4, 1936.

[2] A. G. McCall: "A Note on the Agriculture of the Azande." (Unpublished.)

[3] G. M. Culwick: "A Dietary Survey Among the Zande of the Southwestern Sudan, Sudan Government Ministry of Agriculture," 1950, p. 103.

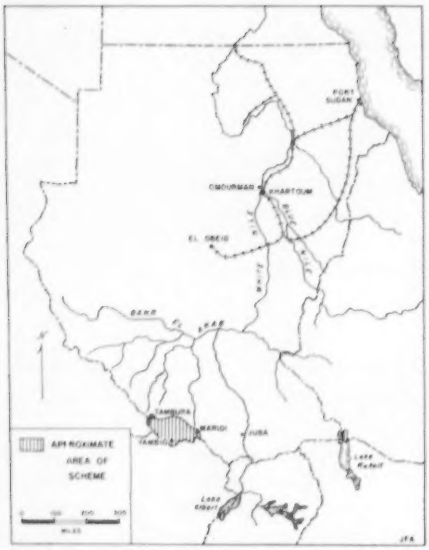


FIG. 1. Sketch map of Anglo-Egyptian Sudan

remoteness, and Dr. J. D. Tothill, formerly Director of the Sudan Department of Agriculture, conceived the scheme as "an experiment for the social emergence of indigenous races in remote areas."[4] His original suggestions, made in 1943, have in large part been adopted, but with several modifications of some importance.

To achieve the "social emergence" and economic stability of the Azande it is planned that the standards of local self-sufficiency be greatly improved, and that provision be made for a limited amount of trade with the northern Sudan to furnish exchange for those necessities it is impractical or impossible to produce in Zandeland.

The scheme has leaned heavily upon the highly successful experience of the Gezira, particularly in the application of science and in the organizational arrangements. Anthropological and ecological surveys preceded the implementation of the scheme, and a nutrition survey was made at an early date. Agricultural experiments were conducted during the war, and a research station has been located at Yambio, while agricultural and forestry schools have been set up to train the Zande workers. The organization of the scheme is similar to the Gezira in that the Equatoria Projects Board is the counterpart of the Sudan Gezira Board as the semi-independent administrative authority. The scheme was officially launched in 1946 with an appropriation of £1,000,000 for the 1946–1951 development period.[5]

AGRICULTURAL ASPECTS OF THE SCHEME

Because scattered and haphazard family plots made supervision and introduction of new crops impracticable, a system of modified and organized shifting agriculture was adopted. Over 60,000 Azande have accordingly been resettled into elongated village units of 50 families known as "gbarias" (Fig. 3).[6] This agglomeration also facilitates educational arrangements, public health, and medical programs.

Each householder has been allotted from 25–40 acres, laid out in long narrow plots with about 150 foot frontage, and running at right angles to the roads or cycle tracks on which the huts are erected. Each "gbaria" is under a paid headman who answers to a chief or sub-chief according to previous tribal custom. The resettlement required by this portion of the scheme was completed in 1950.

Subsistence crops are similar to those

[4] J. D. Tothill: "Agriculture in the Sudan," 1948, p. 916.

[5] "Sudan: The Zande Scheme," *Corona*, July 1951, p. 260.

[6] Hugh Ferguson: "The Zande Scheme," *Empire Cotton Growing Review*, Vol. 26, No. 2, 1949, p. 114. This article has been revised and reprinted as Bulletin No. 14 of the Ministry of Agriculture, The Sudan Government, 1954.

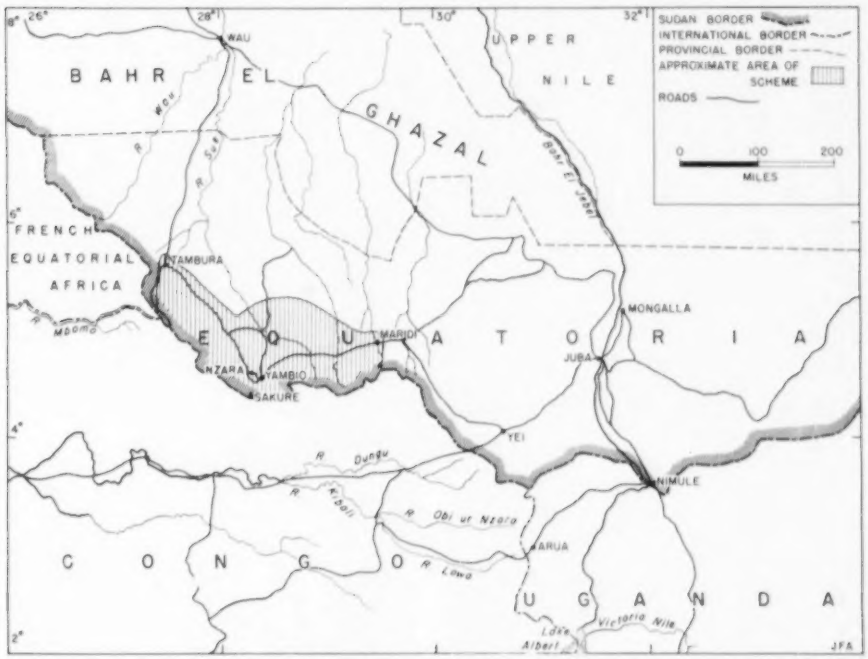


FIG. 2. Location map of the Zande Scheme.

already grown, but emphasis is being placed upon tree crops in order to conserve the soil. Conservation of soil fertility will probably be the most difficult physical problem, and the space allotted to each family was selected because it will permit a long term grass or bush fallow to permit soil recuperation. Because conservation practices were not being satisfactorily followed, a "hedge strip system" has recently been adopted. This involves separating crop strips with permanent, fire-resistant, tree hedges. The use of distinctive trees in each hedge will permit labelling strips so instructions to peasants may be more readily made and comprehended. One of the prime responsibilities of the research station at Yambio will be to continue study of the soil environment.

The problem of soil erosion is being met by requiring strip cropping and contour farming, and by the exclusion of stream fringes and steep slopes from the cultivated areas.

Palm oil production is being handled on a special basis. Scattered 30-acre plantations of high-yielding Nigerian palms are being set out, with ownership of the trees being allotted to the peasants in adjacent villages.[7] It is believed that this system will assure better quality than would otherwise have been possible. Planting of oil palms in cotton plots is also being tried. Production is entirely for local use, the oil being sold to the pressing factory at Nzara for processing.

The economic mainstay of the scheme is cotton, and acceptance of a tenancy requires the planting of at least one half acre to this crop, plus another one-tenth of an acre for each additional

[7] A. G. McCall and J. P. S. Daniell: "The Zande Scheme," text of two broadcast talks, Public Relations Branch, Sudan Government, 1949, p. 6.

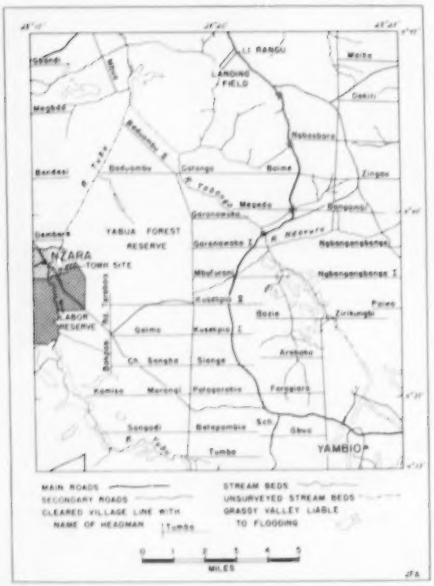


FIG. 3. Detail map of a small portion of the Zande Scheme near the administrative center of Yambio, showing the way in which village lines have been cleared through the bush for the relocation of African settlement, considered desirable for the introduction and supervision of the modified system of shifting agriculture adopted. (Source: Provisional Edition, A. E. Sudan 1/100,000 [Zande Series] Sheet 77-0-3, Survey Department, Khartoum, Oct. 1951.)

wife. BAR SP84 cotton, grown in other Sudan rainlands such as the Kordofan Plateau, was selected as the main variety. Yields, except for the poor climatic year 1952–53, have thus far been better than expected. Some trouble has been experienced with seed germination, but pest and disease damage was light until 1952–53 when increased loss was apparently associated with the poor distribution of rainfall. Some durra (sorghum millet), simsim (sesame), and peanuts have also been grown as cash crops, partly to supply the needs of the Northern Sudanese employed in the industrial center at Nzara.

A number of specialized agricultural operations have been included in the scheme. There are several beef and dairy cattle farms, the cattle being partially maintained on oil cake produced locally and being protected from trypanosomiasis by antrycide injections.[8] A small sugar plantation run by the Board has been started at Sakure, 30 miles south of Nzara in the Nduku Valley, for the production of jaggery, or brown sugar. A final target of 1000 acres of cane per annum has been set. Experiments are being conducted with other crops, including hemp, jute, coffee, tobacco, and tung. It is possible that one or more of these crops may partly replace or supplement the position of cotton in the future.

INDUSTRIAL AND TRADING OPERATIONS

A number of small industrial establishments form an integral part of the program, designed primarily, as is the agricultural portion, to improve the level of self-sufficiency. The most important unit, however, the cotton spinning and weaving plant, is called upon to produce an excess of cloth for sale in the northern provinces of Sudan, and this is expected to be by far the most important source of exchange to pay for required imports. The cotton produced in the Gezira, in the Gash and Tokar Deltas, and even in Kordofan, is exported, whereas textiles are one of the largest single imports into the Sudan. There should, therefore, be a ready market for surplus production from the Zande plant. However, output from a large-scale factory at North Khartoum, which has been proposed, might have serious effects on sale of cloth from the south. The present mill is the smallest spinning and weaving unit that can be run efficiently, but is designed so that additions may easily be made. The first piece of damouria

[8] "Industrialisation in the Southern Sudan," *New Commonwealth*, April 28, 1952, p. 403.

FIG. 4 (upper left). Bush clearing at a homestead in the Zande Scheme. (Photo from Public Relations Branch, Khartoum.)

FIG. 5 (upper right). Clearing the ground after the bush has been removed. (Photo from Public Relations Branch, Khartoum.)

FIG. 6 (lower left). Plot layout on a gently sloping field. (Photo from Public Relations Branch, Khartoum.)

FIG. 7 (lower right). Weeding a plot of cotton. (Photo from Public Relations Branch, Khartoum.)

cloth was produced in September, 1951. On September 11, 1953, when the plant expanded operations to a two shift basis, it was predicted that a rate of production of approximately 2,000,000 yards of cloth annually would be achieved by the spring of 1954.

Other industrial installations, all of which had been completed by 1952,[9] include sugar crushing and evaporating pans at Sakure, and a cotton ginnery, cotton seed crushing machinery and oil extractor, soap making machinery, a saw mill, and a power station at Nzara.[10] The power plant uses charcoal as fuel, and, to assure an adequate, continuous

[9] "The Zande Scheme," Publications Bureau, Juba, Sudan, 1952, p. 4.

[10] "Transforming the South Sudan," *The Economist*, February 23, 1952, p. 475.

FIG. 8. A Zande smallholder and his family picking cotton on their half-acre plot cleared from the bush. About 80 per cent of the population have been resettled in this way since 1946. (Central Office of Information Photograph.)

FIG. 9. Sacks of raw cotton outside the Nzara ginnery awaiting processing. (Central Office of Information Photograph.)

supply, the forestry program includes plans for planting reserves of rapid-growing trees.

At present, skilled jobs in the various plants are held mainly by northerners whereas the Azande are the laborers. It is planned, however, that Azande will take over all jobs in the scheme as they become adequately trained. It should be stressed that industry is definitely secondary to agriculture, as is indicated by the estimate that only 2 per cent of the workers involved will be employed in industry.

One important aspect of the scheme that was not included in the original plans is the Trading Section, which is charged with marketing the products of the scheme, undertaking the wholesale and retail trade in other locally produced and in imported articles, and training of Zande traders. It is intended that this section, with headquarters at Juba, will market useful goods at the lowest possible cost, and that it will prevent outsiders from exploiting the Azande, who lack a trading tradition. About nine shops plus three mobile canteens are run by the section.

CONCLUSION

It is too early to tell whether the Zande Scheme will be successful, but to date progress has been substantial, particularly in view of the primitive state of the area at the inception of the scheme. It was estimated in 1946 that about 30 years would be required to bring the peasantry to a civilized and prosperous, if not wealthy, state.

The peasants have surpassed all expectations in the production of cotton, the totals having been about 8 million

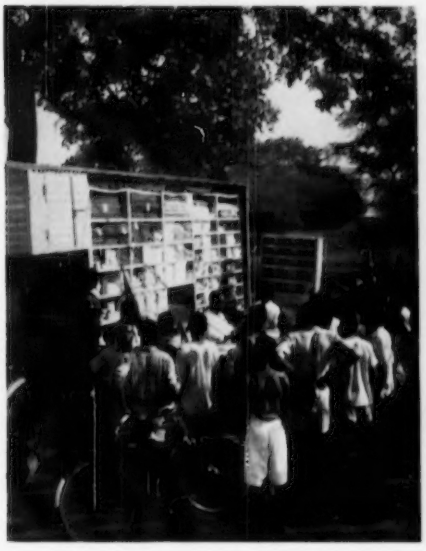


FIG. 10 (left). One of the mobile shops operated by the Equatoria Projects Board, the body controlling the whole Zande Scheme. The original aim was to keep prices down when money was first introduced into Zandeland in what was, for these people, large quantities. (Central Office of Information Photograph.)

FIG. 11 (right). Corner of the large store recently opened in Juba. Besides stocking Nzara-made cloth, soap, and jaggery sugar, many imported goods are sold. (Central Office of Information Photograph.)

pounds in 1951 and 1952. Yields have compared favorably with Uganda or the Belgian Congo. In the first five or six years it even proved profitable, rather unexpectedly, to export at a profit most of the raw cotton. This is not envisaged as a continuing possibility except for the Maridi area nearest the Nile, but it has been immensely helpful in getting the project started on a successful basis. Important, too, has been the willingness, almost the enthusiasm, of the Azande, who have more than fulfilled the part they were allotted. Whether this enthusiasm can be maintained in the face of lower returns is an important test for the future.

The Zande Scheme is an interesting illustration of the evolving attitude of controlling powers toward their non-self-governing territories. This scheme, and such others as the largely aborted Tanganyika Groundnuts Scheme, the Sokoto Rice Scheme in Nigeria, and the Gonja Scheme in the Gold Coast seem to indicate a feeling that backward areas in the colonies must be assisted just as depressed areas have come to receive special governmental attention on the domestic front.

Whatever the outcome of the project, it represents a pioneering effort in the build-up of a remote area, and the scientific manner in which social and physical problems are being approached is impressive.

SUMMER NOMADISM IN TUNISIA

John I. Clarke

Mr. Clarke is an assistant lecturer in Geography at the University of Aberdeen. This is his second article based on field work in Tunisia to appear in this magazine.

THE dusty roads and tracks of Tunisia are the scene of perpetual migrations, but these migrations are most marked during the short spring and autumn seasons. Some men are accompanied by their families, some have flocks of sheep and goats or herds of camels, and some are alone except for their vicious dogs. The luckier ones are mounted on a mangy mule, a donkey, or a camel, but generally the tattered garbs and gnarled bodies betray the poverty of these people. These are not rich people born to wander. No, they must migrate, for if they stay at home they starve. Certainly, most have acquired the nomadic habit from their forefathers, but the necessity remains. They migrate to live.

Where do they originate, these people? Where are they going and why? What problems will they have to face? These are the questions which we must attempt to answer.

Tunisia Before the Protectorate

In the middle of the nineteenth century the country was extremely backward due to Turkish misrule and anarchy. It was in a state of economic stagnation, endemic diseases and poverty were rife. The population depended almost entirely on a poor agriculture and suffered from the vicissitudes of the climate. Therefore, during a period of drought the strife was appalling, especially in the steppe and semi-desert lands south of the mountains of the Tell or Dorsale (Fr: "backbone"). There the climatic variability is high and the principal mode of life was pastoralism; hence the people felt the need to migrate towards the more favored regions of the Tell to pasture their flocks or to find work.

But climatic conditions alone are insufficient to explain this phenomenon. In fact it reflects the instability of both climate and economy, but it must be emphasized that the types of economy are not determined by climate alone and that other factors, historical and human, intervene. Thus the creation of widespread olive-plantations over the steppes during Roman rule meant the retreat of pastoral nomadism towards the desert, but their destruction during the Arab invasions of the 11th century reversed the situation. For nine centuries the nomad ruled the steppes, and only today are we witnessing again the extension of olive-culture. So the land use of the steppes depends above all on the stability of the government; the migrations are due to drought and want.

Under the Turks the nomad reigned supreme in the steppes, but there existed a certain harmony or equilibrium between steppe and Tell: a community of interests. During the summer drought, the nomad of the steppes (sometimes known as a semi-nomad to distinguish him from the true nomad of the desert) sought the greener pas-

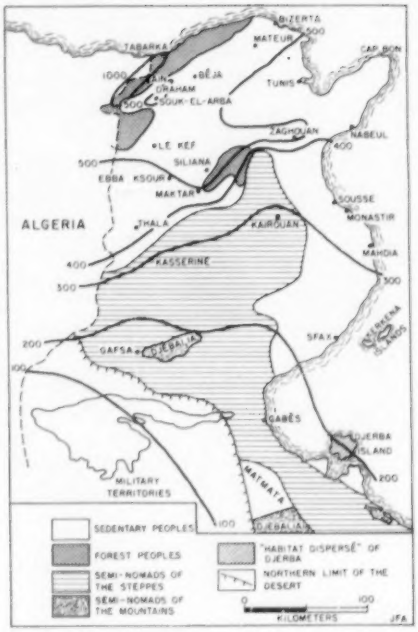


FIG. 1 (left). General map of Tunisia, showing relief.

FIG. 2 (right). Types of economy (as delimited by Jean Despois) and annual rainfall (in mm.).

tures and lower temperatures of the Tell (Ar: "Friguia") to work as a harvester in its fields of grain and in its olive-groves. In winter the farmers of the Tell sent their flocks down into the mild plains so that they might escape the rigors of the mountain weather. Moreover, these seasonal migrations had a commercial aspect: dates, cereals, and olive oil were exchanged.

TUNISIA SINCE 1881

Since the establishment of the French Protectorate in 1881 the picture has vastly changed. The contact of European and Móslem civilizations has not taken place without severe shocks and knocks in all spheres of life.[1] European colonization, and the consequent agricultural development of the Regency, has profoundly modified the cultural landscape, but it has been most marked in the moister lands of the Tell: in the valley of the Medjerda, the plains of Tunis and the Cap Bon peninsula, and the northern part of the High Tell. There French and Italian farmers, especially the former, have introduced modern intensive farming and many Tunisians have followed suit. The concentration of Europeans in the towns—Tunis, Bizerta, Sousse, and Sfax—has actuated a large-scale movement of people from the country to the town, which poses immense problems of urban development. However, this movement is very complex and will not form a part of this present study. In the steppes European colonization has been far more scattered, and except in the Sahel and the hinterland of Sfax, the

[1] J. I. Clarke: "The Population of Tunisia; an example of contact between Modern Civilization and the Moslem World," *Econ. Geogr.*, 1952, pp. 364–371.

TABLE I

RAINFALL DATA IN MILLIMETERS FOR METLAOUI

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1946	70.0	0.2	0.0	20.8	17.3	0.0	0.0	0.0	0.0	10.6	3.6	0.0	131.5
1947	1.3	5.6	0.0	2.2	14.3	0.0	8.1	15.3	0.0	20.8	3.2	41.6	112.4
1948	2.4	21.6	8.2	4.7	2.6	10.4	0.0	0.0	7.9	3.6	5.1	25.8	92.3
1949	39.5	1.6	35.4	82.8	1.2	0.0	0.0	25.3	0.0	5.0	0.6	16.8	206.2
1950	22.6	1.4	16.0	19.8	0.4	0.6	2.5	4.5	33.6	30.0	5.0	4.2	140.6
Mean averages, 1901–1950	15	11	16	14	11	5	1	7	14	13	17	13	137

old and new regions of olive production, pastoral nomadism still holds sway.[2]

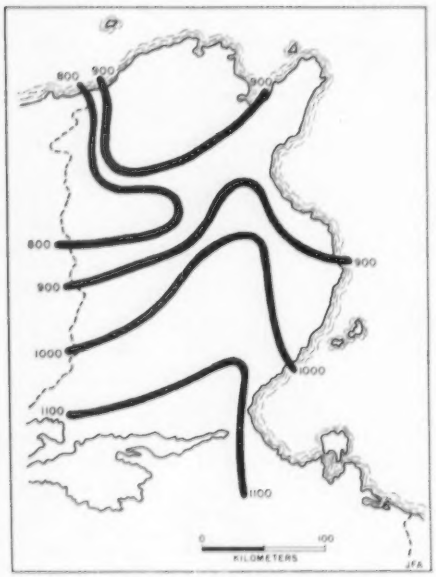
Tunisia is now in a transitional stage of disequilibrium, of social and economic disharmony: disharmony between steppe and Tell, town and country, European and Moslem. . . . We are interested in the way this disharmony affects the nomad migrating northwards.

THE AIMS OF SUMMER MIGRATIONS

It has been stated that summer migrations have two distinct aims: pastures for flocks, in which case the migration is known as transhumance, or work at the harvests. We consider the two aspects separately, although there are not two clearly distinct migrations. Transhumants and nomadic workers are attracted by the same regions at the same time and in the same years, and many transhumants seek supplementary work. On the other hand nomadic workers are invariably accompanied by a few sheep or goats. The two aspects have the same cause: drought in the steppes and the contrast between the rainfall régimes of these regions and that of the Tell. The seminomads depend on the autumn and spring rains ("former" and "latter" rains) for their pastures and harvests; if either fails they are forced to abandon the parched steppes in search of subsistence for themselves and their flocks. They are at the mercy of the rainfall, and their migrations follow its dictates. During a favorable year the volume of summer nomadism is negligible, whereas after two or three years of drought 200 to 300 thousand people from the steppes and the greater part of the flocks may be found in "friguia." Such was the case in 1947 and 1948, for the drought had persisted since 1945. If the "happy lands" of the Tell also suffer from the drought, then it is a veritable catastrophe: famine, want, and disease.

Rainfall averages mean little unless such factors as variability, humidity, evaporation, and transpiration are fully realized. The monthly rainfall statistics for Metlaoui, a phosphate mine near Gafsa in typical steppeland, over a five year period show the variability factor (Table I). Thornthwaite's index of potential evapo-transpiration (see Figs. 3 and 5) is particularly interesting in relation to summer nomadism because it shows the amount of water which would be evaporated and which would be transpired by plants if the soil contained a sufficient amount of moisture; herbaceous plants are affected before trees and bushes, so cereals before olive trees.

[2] It is not our intention to study the localized movements of pastoral nomads in the steppes and pre-Saharan regions south of the chotts. For information on this subject see: P. Bardin: "Les jebalia de la région de Gafsa," *Revue tunisienne*, 1939, pp. 87–126; "Les populations arabes du contrôle-civil de Gafsa et leurs genres de vie," Tunis, 1944; J. Despois: "La Tunisie orientale. Sahel at Basse Steppe," Paris, 1940; P. Moreau: "Des lacs de sel aux chaos de sable. Le pays des Nefzaouas," Tunis, 1947.



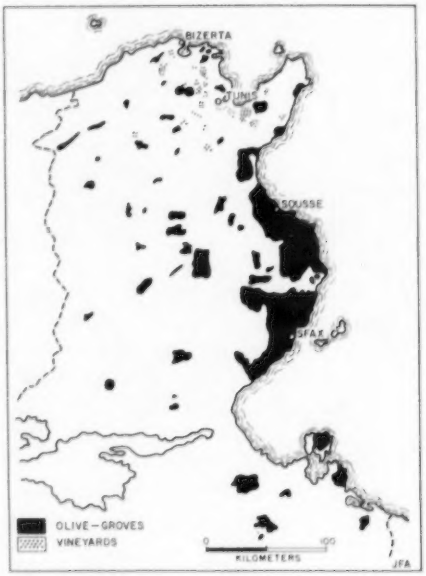


FIG. 3 (left). Total potential evapo-transpiration per annum (in mm.).
FIG. 4 (right). Distribution of olive groves and vineyards in Tunisia.

TRANSHUMANCE

First of all we must define our terms. In French North Africa, as elsewhere, a great deal of confusion exists as to the precise meaning of such terms as transhumance, nomadism, and semi-nomadism. Various classifications have been suggested[3] but none has been universally accepted. Different observers look at the nomads from different angles.

In Tunisia, transhumance means the seasonal pastoral migrations from steppe to Tell in summer and from Tell to steppe in winter. We retain this use of the term despite the fact that, unlike transhumance in Europe, the summer migration or "estivage" usually involves an important human contingent, and only in good years, when flocks migrate under the guidance of shepherds, is the word transhumance really applicable. So Tunisian transhumance has few affinities to Alpine transhumance, and even differs greatly from that of Algeria and Morocco. In these two countries the caravan still prevails.[4]

Winter transhumance or "hivernage," which may conveniently be dealt with here, is a fairly regular movement of flocks accompanied by shepherds from the cold damp hills of the Tell down to the steppes, where pastures are cheap and easily found. Thus from November onwards many flocks from the Cap Bon peninsula, the northern Tell and the lower valley of the Medjerda go down to the plains of Kairouan and Sidi Bou Zid where they meet other flocks from the regions of Maktar and Siliana. With the rise of intensive cultivation in the north this movement is increasing,

[3] See, for example, A. Bernard and N. Lacroix: "L'Evolution du nomadisme en Algérie," Algiers, 1906; P. G. Merner: "Das nomadentum im nord-westlichen Afrika," Stuttgart, 1937; J. Despois: "L'Afrique du Nord," Paris, 1949.

[4] L. Lehuraux: "Le nomadisme et la colonization dans les Hauts Plateaux de l'Algérie," Paris, 1931, and "Où va le nomadisme en Algérie?" Algiers, 1948.

for farmers there have difficulty in finding good pastures. So in a normal year, if such a year exists, winter and summer transhumance are numerically about equal. Such is not the case in a bad year, for then the summer transhumance outnumbers the winter transhumance several times.

Summer transhumance may mean a simple movement of flocks to better pastures, or it may mean a mass exodus of flocks menaced with starvation. It may be small and profitable, or it may be immense, ineffective, and completely beyond control. In 1945, 26,000 animals left the Caïdat of Gafsa; the following year only 4,000. This irregularity makes it a great bane to the Tunisian economy. It depends entirely on the state of the pastures. Thus although the departure generally occurs in April, it may happen in December if autumn rains are lacking, and, inversely, with abundant autumn and spring rains most of the tribes will be able to find sufficient pastures and avoid the tiring trek towards the Tell. Only on the most barren lands of the High Steppe—for example, among the Ouled Sidi Tlil southwest of Kasserine—where the young olive plantations are limited in extent or lacking, are the flocks forced to transhume annually.

In the days before the Protectorate the families travelled together in "smala," or large caravans, to protect themselves from the attacks of brigands. No longer fearing such attacks, they now journey in small groups in daily stages of about 12 miles to well-known water holes along the traditional tracks. Many of these tracks are now tarmac roads bordered by corn fields or olive plantations, and frequently flocks and vehicles hinder each other, to the detriment of the former.

The tribes, fractions, and families tend to follow the same routes and to frequent the same regions year after year (see Fig. 6). So the semi-nomads of the High Steppe, the Hamama and the Fraichiche, who are fairly regular transhumants, converge on the hills around Maktar and Le Kef, and later on the rich plains of Souk el Arba and Béja in the middle valley of the Medjerda. But they go only as far as this if they can find no pastures nearer home. Some cross the frontier and find pastures on the lands of friendly tribes in Algeria. This is a reciprocal arrangement, and in fact the Algerians take more advantage of it. Djelass, Souassi, Mehedba, Neffet and Aguerba, tribes of the Low Steppe, have never transhumed regularly except during periods of great drought, when they would follow the famous "trik el mehalla" from Kairouan northwards towards the eastern part of the Tell and the middle

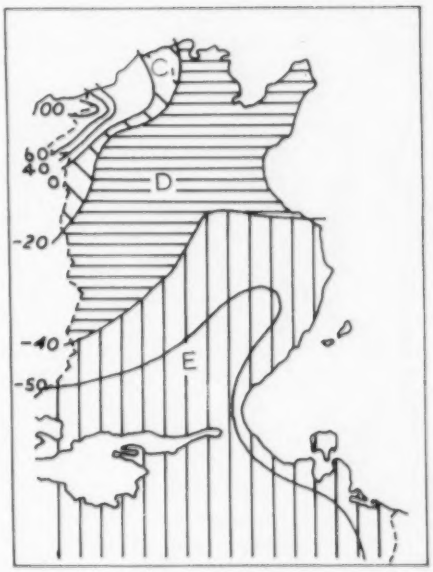


FIG. 5. Moisture regions based on Thornthwaite's 1948 classification. Note: Tunisia contains the whole range of climatic types from perhumid (A, 100 and above) to Arid (E, −60 to −40), but most of the country is classified as Semiarid (D) to Arid.

and lower valley of the Medjerda. Now more and more are giving up nomadism and becoming sedentary farmers.

If the group of transhumants consists of several families, one man is usually sent ahead to make arrangements for pastures, but they are not paid for unless the flock remains longer than 24 hours. Formerly, the flocks grazed the large areas of bush and waste land, the grass fallow, and the stubble-fields, and pastoralists of steppe and Tell often had reciprocal agreements for the free use of each other's pastures. Furthermore, as during past periods of drought and famine numerous families and fractions of the tribes of the steppes settled in the Tell, many transhumants were able to pasture their flocks with relatives or friends. Some families even owned land in the Tell. The payment of pasture rights was not nearly so widespread as at present.

The problem of procuring pastures for the flocks becomes more and more complicated. The areas of intensive colonization, where the cultural landscape has been completely altered, are in precisely those areas formerly frequented by the transhumants. In all, 750 to 800 thousand hectares have been colonized by Europeans in Tunisia, which is about one-fifth of the cultivated area. Vast domains (e.g. Enfida and Sidi Tabet), private land or "melk," and later, "habous,"[5] were acquired by the French and Italian colonists. Forests and bush land were appropriated and cleared, and soon large expanses of cereals, olive plantations, vineyards, and orchards reduced the pastures available to the transhumants. Now numerous restrictions are imposed on the use of the remaining forest land, in order to save the trees from the depredations of goats and to stave off soil erosion. The transhumant is barred. In certain areas modern methods of wheat growing have made transhumance a mere anachronism. The biennial rotation of wheat and bare fallow was quickly adopted by colonists practising the monoculture of wheat in areas receiving less than 500 mm. of rainfall a year. Unlike Moslem farmers, they have few animals and therefore no interest in adhering to the traditional system of grass fallow, which in any case gives lower yields. Then again, the burning of their stubble to destroy a harmful parasite (cecidomyia) caused them less inconvenience. But the European farmers are not alone, for many large Moslem properties have rapidly imitated western methods.

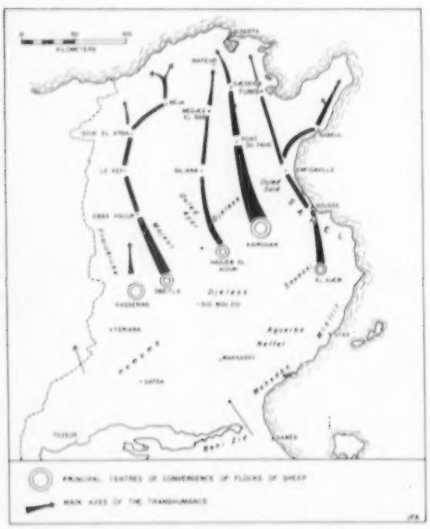


FIG. 6. Axes of the summer transhumance.

Reciprocal agreements between nomad and farmer are rarer, for in "friguia" tribal ties are looser and the individual sense of private property stronger. Farmers, Tunisian and European alike, demand payment for the use of their pastures. Usually a certain piece of ground is rented for a specific time, commonly one month (and known

[5] Land dedicated to some pious purpose and known as "waqf" in the Middle East.

as "achaba"), but there is no rule. The price of pastures, their extent, and the duration allowed for use, vary according to the richness of the vegetation and the volume of the transhumance. So when the year is bad, the grass dry, transhumance great, and the people poor, the prices are high; then wrongful use of pastures, robberies, and fights frequently trouble "friguia," and animals die of hunger and exhaustion (Fig. 7). Such is the tragedy so often re-enacted in recent years.

There are exceptions, but they are rare. For example, there are rich farmers in the Sahel who can afford to send their flocks northwards in lorries, so that they are not weakened by the exhausting journey on foot. In 1951, about one-third of the flocks transhuming from the Sahel went in this fashion. But this is a very small fraction of the total movement, and it comes from a very special area where olive plantations and village agriculture have existed for centuries.

The government aims at canalizing the flocks towards the areas capable of receiving them. Control is essential, but it became effective only in 1936 when each caravan was issued with a card giving full details of its composition, origin, destination, route, and state of health. This stringent supervision loses much of its effectiveness during great droughts. Theoretically the government regulates the movement by three main agencies: policemen to ensure security, veterinary posts to inoculate the animals against foot-rot and foot-and-mouth disease, and medical posts to prevent the spread of typhus and malaria.[6] Of course, misery and poverty accentuate the danger of disease. Plans for facilitating transhumance by the creation and improvement

[6] See Ch. Henry: "La lutte antipaludique en Tunisie," Paris, 1939.

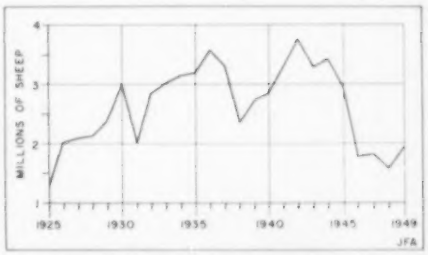


FIG. 7. Fluctuations in the number of sheep, 1925–1949. Note: 200 mm. of rainfall per annum are necessary for the well-being of sheep. Malnutrition and its consequence, disease, have disastrous effects on the flocks. The years of drought can easily be seen from the graph.

of wells, the enlargement of tracks, and the provision of forage reserves are only slowly put into action due to the lack of funds and the irregularity of the phenomenon. But these are mere palliatives; the root of the trouble lies in the steppes.

MIGRATIONS OF HARVEST WORKERS

Intimately connected with transhumance is the migration of harvest workers from the zone situated south of the 400 mm. isohyet—which marks approximately the limit between steppe and Tell—toward the north, in order to take part in the harvest and bring back provisions for the winter. Generally, these are the poorest inhabitants of the steppes: those with few animals and no trees, like the Ouled Moussa and the Ouled Affial of the Caidat of Kasserine. But many families go north for the dual purpose of finding pastures for their animals and work for themselves.

It is evident that the importance of this migration is directly related to the state of the harvest throughout the country. It depends as much on the needs in the steppes as on the promises of gain in the Tell. These needs vary from year to year, for never can the

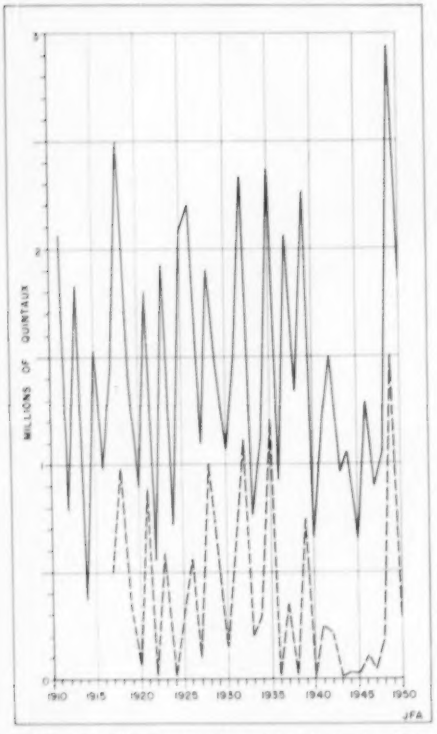


FIG. 8. The production of hard wheat. The solid line shows production by Tunisians, 1911–1950. The broken line shows production in the central and southern parts of Tunisia, 1917–1950. Note: The Tunisians grow very little soft wheat, in spite of its favor among French farmers. The fluctuations in the production of hard wheat in the central and southern parts of the country are tragic.

wheat grower of the steppes be sure of his return (see Figs. 8 and 9). In some places he expects only one good crop in five, but it may be of astounding proportions. With primitive methods of farming the Arab cannot be impatient and is apt to lapse into fatalism. The crop of one year determines the migrations of the next; thus during a year which appears to be bad but which succeeds an excellent one, stores of grain keep the people at home. Although averages mean little in this land of fluctuations, this migration of harvesters is slightly more regular than the transhumance, and it has been estimated that about 50 to 60 thousand journey north every year: about one-tenth of the inhabitants of the steppes.

The departure is in April or May. Sometimes a reconnaissance man is sent ahead to make arrangements for work, but usually few preparations are made. The young and healthy sally forth with their womenfolk—for the women will do more than their fair share of the work—with only enough animals for their needs in milk and transport. They stop where there is harvesting to be done, and wander from farm to farm until the harvest season is over.

At the harvests the nomads are paid in kind. They should receive about one-tenth of the harvest, but this amount varies according to the availability of labor, the state of the harvest, the fear of frost and the size of the farm. Consequently, they may receive anything from one-half to one-thirtieth; it differs from year to year, from week to week and from farm to farm. Only when there is an agreement between the farmers is there any widespread similarity of payments. Unfortunately, the controlling factor is the quantity of labor available, so it is during the poor years that the harvesters receive the smallest share. When they set out in April they have little idea of how many, if any, sacks of grain they will carry back for winter provisions in September. They hope for five or six. Perhaps; but at least they should find enough food for themselves and their animals during five or six months, for often the landowners tolerate them pasturing their flocks on the stubble.

The problem does not end there. Since the war more and more farmers of the rich plains of the middle valley of the Medjerda and other fertile re-

gions, have acquired tractors, combine harvesters, and other machinery, and many have neither draught animals nor stock. The farms around Medjez el Bab are typical. Between 1948 and 1952, Tunisia imported 2880 tractors, 884 combine harvesters and 6842 other farm machines, making totals of over 8000 tractors, 3575 binders, and 2311 combine harvesters. The Europeans especially have resorted to mechanization, but so have those Tunisians possessing large or medium-sized properties. Only the small farmers have retained old methods. The effect is two-fold: not only do these farmers employ a minimum of labor for the harvests, but they re-employ for this purpose those surplus hands whom they discharged because of mechanization. Can the farmers of the north be blamed? For years they had been entirely dependent on the nomads, the most unreliable of workers. If the harvest was ample in the center and the south the nomads stayed at home. This was the case in 1932 when in the region of Le Kef the wheat was left uncut. Now the nomad finds that he is no longer indispensable, but his needs are just as vital as ever.

The majority of the migrant harvest workers return home once the harvests are over, for in the steppes it is the season of the prickly pears, an important item of food for man and beast. And if it has rained at home there is sowing to be done; if not perhaps they will stay in the north, for the north offers other sources of employment. In the Cap Bon peninsula and on the plains around Tunis the vintage season occurs between August and October. About 20,000 people from the Low Steppes find work there every year. While at work they eat their fill of grapes, but their payment takes account of this. Others stay in the north to help in the olive harvest in December, January and February, but the major olive districts are the Sahel and the area around Sfax (see Fig. 4).

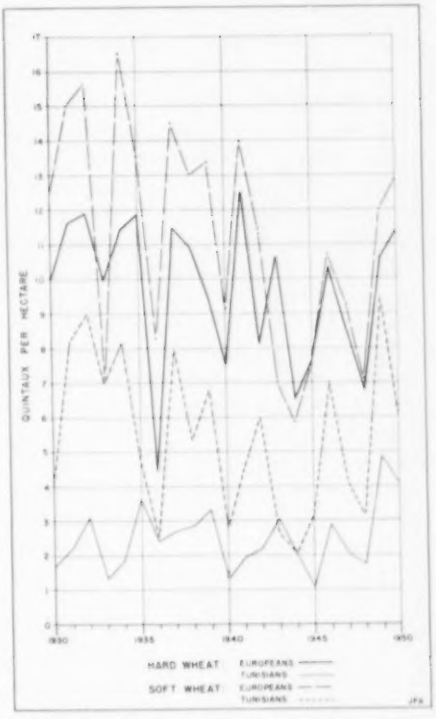


FIG. 9. Fluctuations in the wheat yields, 1930–1950.

SETTLEMENT OF NOMADS IN THE NORTH

For centuries there have been nomads who have settled down in the north and gradually lost their ties with the mother tribe. They have done this when drought has ravaged the country. Farmers have given them employment and eventually these ex-nomads have amassed enough money to buy land of their own. Consequently, a multitude of small fractions of steppe tribes are scattered throughout the Tell: fractions of the Djaouada, the Ousseltia, the Hamama, and others. The fertile Cap Bon peninsula is a hotchpotch of such

fractions. If they stay in the country they lose their tribal ties slowly, and there are some who never give up the idea of returning to their native home. This was the aim of a sheep farmer from Sbeïtla. In the 1930's he had about one thousand sheep, half as many goats and several cows; in fact he was a rich man. But the war and the terrible droughts of the early postwar years left him with just a score of goats. So he went off to work on a farm near Ebba Ksour—to work so that he could rebuild his flock. Three years later he came back, and now he owns a flock of at least three hundred sheep.

It is a different story if the nomads are forced to drift towards the towns to find work. Ties with the homeland are soon lost in the tightly packed native quarters of the cities, and although the nomad retains his family pride, his visits home become more infrequent with the passing of the years. He likes the hustle and bustle of town life as well as its amenities. But he lives in a quarter that is inhabited by other folk from his home district, and in the evenings they congregate in certain cafes where they enjoy the gossip and news from the relatives who stayed at home. An interesting feature is that some tribes and villages tend to specialize in and even monopolize certain industries or occupations, although this specialization is more marked amongst the village and oasis dwellers of the south.[7] For example, 1200 people of the small tribe of the Labaieudh, whose home is near Sbeïtla, have settled at Hammam-Lif, south of Tunis, where they have worked in a lime works since 1946. These are the lucky ones for they have a regular job.

Since the war there has been a mass movement towards the towns, especially those inhabited by Europeans: Tunis, Bizerta, Sousse and Sfax. Driven by hunger, the nomads arrive in thousands during a bad drought, despite a tight police cordon around the cities. It is a pitiful sight; nomads once noble and proud reduced to poverty. Their homes are often holes, hovels, or brushwood bivouacs on the outskirts of the city, and their wives and children, always with outstretched hands, cluster along the crowded streets and alleyways of the medina. They hope to find their daily wants, but with little skill and, let it be said, often little desire for hard work their chances are few. Begging is the last resort. They bring disease and discontent and are a constant source of anxiety to the civil authorities. The shanty towns around the large cities are hotbeds for political fanatics. What can be done with these people? Are they to be sent back home? Are they to be incorporated in the urban development? A solution which satisfies both nomad and town dweller, both Moslem and European, is very difficult to find.

[7] This specialization can form the subject of an interesting study, but it is beyond the scope of this article.

THE SOLUTION?

The picture is not pretty. Summer nomadism was once a natural feature of the economy of Tunisia. Now colonization and modern agricultural methods have vastly reduced the attraction of the north, but the impulse from the steppes, the impulse of drought and hunger, is still there, and with the spread of medicine a rising population aggravates still further this complex problem. Summer nomadism was once a profitable migration involving commercial exchange and barter; it is now a necessity. During a drought the government is compelled to supply large quantities of food to the starving thousands, and to form road construction

and repair gangs to alleviate unemployment. These are no solutions.

Where then does the solution lie? In the steppes. There the fortunes of the herders fluctuate with the condition of their flocks. Forage reserves are very limited—the recent expansion of the *cactus inerme* has improved the situation a little—so the semi-nomads are unable to withstand two or three bad years. The animals die or are reduced to a wretched condition, and the reconstruction of the flocks takes a long time. Of four lambs (if we assume that half are males), two are sold or eaten, one replaces an old ewe, and the other increases the flock. Taking into consideration the possibility of sickness among young lambs, a good lambing year will generally increase the flock by less than 20 per cent. Furthermore, the nomad must pray for plentiful autumn rains, because it is then that the lambing takes place and the needs of the ewes are greatest. Of course, autumn rains are never reliable. The poor nomad is always at the mercy of the climate.

So forage reserves must be increased, above all by expanding the growth of the cactus. Sheep farming must be made more stable. The decrease or loss of a flock is both a cause and a consequence of the sedentarization of nomads, and the use of the "gourbi" (type of mud hut) instead of the tent is almost always a sign of impoverishment. Sedentarization means greater stability in standards of living only if it is well-planned. Unfortunately, the local administrators, realizing that the long-term solution lies in the development of arboriculture, have not devoted enough time and money to the present requirements of the nomad. Perhaps this is because colonists in Tunisia have never taken any real commercial interest in stock raising. All available funds have been utilized to enlarge the area of olive plantations, and much work has been admirable, but frequently the rationalization of sheep farming has not preceded the planting of the trees. So in waiting for the fructification of the trees many nomads, with reduced flocks and pastures, found themselves even more at the mercy of a drought. At such times many rich sheiks and landowners profitably extend their properties, and more people join the ranks of those who wander northward in summer in search of food.

But trees are the eventual solution: trees, trees and more trees. The nomad must be sedentarized, or as the French say "fixé au sol," and as it is arid soil only drought resisting trees will suffice: the olive, the apricot, and the almond. This cannot be done in a few years because these trees take a long time to fructify, and the nomad takes even longer to throw off his habits and acquire those of a farmer. For instance, centuries of collective tribal tenure cannot be forgotten in a year or two. So some schemes have not been very successful. It is true that several tribes have been more or less settled, like the Ouled Sidi Ali ben Aoun in the "Contrôle-civil" of Gafsa, but elsewhere few changes have occurred. Problems of land-ownership,[8] of water and irrigation, of credits, of illiteracy, and psychological attitudes caused by long traditions of pastoralism . . . all complicate the task of facilitating the transition from pastoral nomadism to the cultivation of fruit trees. But there lies the future well-being of the inhabitants of the steppes.

[8] The two principal forms of land tenure in the steppes are: (a) "arch" or collective ownership; (b) "habous."

GEOGRAPHICAL DISTRIBUTION OF PETROLEUM REFINING CAPACITIES:

A STUDY OF THE EUROPEAN REFINING PROGRAM

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AFTER World War II, West European countries suffered from serious deficits in their foreign payments accounts. These deficits were due to the need to repair the ravages of war, loss of revenues from overseas, and general deficiencies in supplies of food and raw materials. To restore balanced foreign exchange accounts the various West European countries decided to increase their exports through a rapid increase of productivity above prewar standards. In this attempt, Western Europe was handicapped by insufficient local coal production, and also by the fact that the mobility as well as the speed of modern industry and agriculture are better supported technically by a high rate of oil than of coal consumption. To raise productivity required, therefore, the availability of petroleum products in far above prewar quantities. Since local crude oil production can cover only a fraction of West European requirements (including shale oil, less than 5 per cent in 1952), large quantities of oil have to be imported from overseas; and thus, in postwar years, oil became actually the major source of deficits in the West European balance of payments accounts.

To reduce this particular cause of deficits, several European countries decided to import crude oil and refine it within their own territories into the required petroleum products, rather than, as until now, import the more expensive petroleum products from overseas. However, to prevent wasteful construction of excess refining capacities, the Organization for European Economic Cooperation (O.E.E.C.), set up by the governments of Austria, the Benelux countries, Denmark, France, Greece, Iceland, Ireland, Italy and Trieste, Norway, Portugal, Sweden, Switzerland, Turkey, United Kingdom, and (Western) Germany, cooperating with agencies of the United States, decided to examine the refining plans of the various member countries, and to draw up a coordinated program of refinery construction and expansion. In agreement with the participating countries, O.E.E.C. was empowered to delay, but not to prevent, the construction or expansion of refining capacities of which it did not approve. While it is virtually impossible to make a straight calculation of the net foreign currency saved by participating countries through the refining program, estimates show that between 1949 and 1953 about $450 million less of scarce foreign currency was spent on purchases of petroleum abroad by means of the investment in refining capacities of slightly over one billion dollars, largely paid for in currency of the participating countries, as well as out of their dollar earnings (about $140 million) and United States aid of about $30 million. The reports of the O.E.E.C. committee in

TABLE I

TYPES OF REFINERY LOCATIONS

(Capacity in U.S. barrels per day)

Type	*Location Characteristics*	*Typical Crude Oil Processing Capacity Today*	*Examples*
1. Resource refineries	Located in the economic region of their significant crude oil supply, delivering products to this region and elsewhere	Very small (under 1,000 b/d) to medium sizes (usually under 30,000 b/d, frequently under 5,000 b/d	Shelby, Mont., 700 b/d Alwand (Iraq), 8,000 b/d El Dorado, Ark., 22,000 b/d
2. Seaboard-export refineries	Connected by pipeline or barge transportation to their local or distant oil fields. Delivery of products by tanker to distant markets as well as supplying local markets. In view of close connections to oil fields seaboard-export refineries are basically related to resource refineries	Medium to very large, 20,000 to over 200,000 b/d	Destrehan, La., 20,000 b/d Baytown, Tex., 260,000 b/d Abadan, Iran, 500,000 b/d
3. Market refineries	Located in economic regions without significant oil resources; delivery of products to local markets primarily	Small to large, 1,000 to 200,000 b/d	Denver, Colo., 9,000 b/d La Plata (Argt.), 85,000 b/d Linden, N. J., 138,000 b/d

Note: Capacities are estimated performances of plants and allow for "shut-down" due to cleaning and usual repair. For short periods refineries may operate at rates higher than the capacities given here. In general, operations take place at rates considerably lower than capacities given, which explains the gap between capacity and consumption for example in the data for the Netherlands.

charge of these programs and examinations have provided part of the statistical and other material for this study.[1]

LOCATION DETERMINANTS AND PATTERNS

Under normal conditions the location of processing plants is determined by the ratios of the costs of transportation of raw materials to finished products. Further, the cost of processing in specific locations, as well as the prices of raw materials and finished products, influence processing locations, although in the case of bulky products like petroleum this is of lesser significance. In postwar Europe, however, "the paramount need to conserve foreign exchange . . . demands . . . the subordination of (these) purely technical oil economics to balance of payments considerations."[2] Questions, therefore, arise as to what extent the geographical distribution of refining capacities resulting from this economic policy differs from the geographical distribution of refining capacities in other parts of the world, and as to whether any world-wide trends in the location of refineries can be observed.

The basic types of refinery locations that can be distinguished are shown in Table I.[3]

A part of the European crude oil production is refined in resource refineries. For example, Pechelbronn (Alsace) crude oil is refined in a plant in nearby Merkwiller (1600 b/d). Similar locations are found in Lower Saxony, Northern Italy, and Eastern Austria. However, the bulk of West European crude oil production is refined in market refineries which process primarily imported material (e.g., in or near Hamburg, Rotterdam, etc.). In all these cases local crude oil production followed upon the establishment of the

[1] Principally the First (Oct. 1949), Second (August 1951) and Third (June 1953) Reports on Coordination of Oil Refinery Expansion in the O.E.E.C. countries, published by the Organisation for European Economic Coordination, Paris.

[2] Quoted from First Report, *ibid.*, p. 5.

[3] Following, principally, E. R. Lilley, "The Oil Industry," New York, 1925, p. 438ff.

refineries, respectively, was of little significance in determining their location. The overall growth of capacities of resource refineries in Western Europe has been smaller than the increase in local crude oil production. This indicates advantages of processing in market refineries, though some of these market refineries were established or expanded for reasons of foreign exchange considerations.[4] Since no products from the refining of West European crude oils are exported, there are no plants with the characteristics of a seaboard-export refinery. Thus, practically all the capacity built under the aegis of O.E.E.C. is market located.

CAPACITY AND YIELDS OF PLANTS

In considering plans for the construction or extension of refineries, O.E.E.C. had to pay thorough attention to the size and composition of the market for the product of any proposed refinery. Size is important, for, due to economies inherent in the handling of fluids and gases, large refineries offer significant advantages in lowering costs of processing. According to the patterns in sizes observable in Table I, third column, this advantage appears to be most marked in seaboard-export and market locations. Since "in Europe there are certain centres where . . . concentration of refining capacity in large units . . . is possible without increasing unduly the cost of transportation from such centres to the consuming areas,"[5] in fact, the geographical configuration of the demand for petroleum products encourages the location of market refineries.

The composition of the demand for petroleum products is equally significant. According to their origin, crude oils contain various percentages of products in physical mixture, that are separated by distillation and condensation during the refining process. For example, Middle East crude oils, which form the bulk of European supplies, yield by volume about 20–22 per cent gasolines, 18–20 per cent middle distillates (diesel oils and gas oils, etc.), and 43–45 per cent residual fuel oils (balance of other products and loss in refining). The yield of gasolines can be raised by means of cracking (chemical) processes at the expense of middle distillates, and to a lesser extent also of fuel oils. For example, the average yield of gasolines obtained by cracking from Middle East crude oils in Northwest European refineries is 27 per cent. Individual plants may have higher yields; however, there are serious economic limitations to substantially higher rates of gasoline production from Middle East crude oils. Should the composition of demand for petroleum products not match refinery yields in a particular area, and attempts be made to supply the whole of the demand for one product, there will be surpluses in other products. For example, Norway's consumption demands over 70 per cent of middle distillates and fuel oils; to cover these requirements from Middle East oils would yield a substantial surplus of gasolines, which, in the absence of sufficient motor cars, etc., could not be consumed locally. The re-export of such surpluses may be uneconomic, for these products will have to carry their portion of the freight of crude oil from point of origin to refinery, as well as freight from refinery to the distant consumer, com-

[4] The larger Austrian refineries were originally established as market refineries to process Rumanian crude oil imported by Danube tankers. Today, these plants refine local crude oils exclusively. As three quarters of the Austrian refineries are located in the Soviet Zone, only estimated data for their capacities are available, and Austrian refineries are therefore excluded from O.E.E.C. studies. However, Austrian data on oil consumption are included in O.E.E.C. reports.

[5] Quoted from First Report, *op. cit.*, p. 6.

pared with the single long-distance haul for a product refined in a resource or seaboard-export plant for delivery to the same consumer.[6] For this reason imbalances in product demand and product yield favor, in general, seaboard-export, and to a lesser extent resource refineries, rather than market located plants.

Equipment for cracking facilities to raise yields of gasoline is costly, and has to be imported to some extent from the United States. Thus, imbalances of demand and supply also cause additional foreign exchange shortages, which have affected or delayed the expansion of petroleum refining capacities in some instances. The rapid expansion during recent years of European manufacture of specialized refining equipment has reduced these foreign exchange difficulties. Gasoline, suitable for consumption in modern automobiles, etc., must contain a percentage obtained in cracking processes, as well as some other special chemicals. For this reason all large European refineries contain some cracking equipment.

EFFECT OF PHYSICAL GEOGRAPHY

The effect of the physical geography of Western Europe with its long and deeply indented coastlines, and its many navigable rivers and canals is seen in the relatively high rates of gas-oil and diesel-oil consumption (23 per cent in Europe in 1952, compared with about 15 per cent in the United States). In Europe, for reasons of taxation, these products are consumed primarily in coastal and inland navigation, as well as in trucking.[7] Overall refining yields and capacities are adjusted to these requirements. On balance, West European countries refine their requirements of gas-oil and diesel-oil, thus leaving a steady deficit of kerosene and aviation gasoline, as well as special lubricants to be imported from overseas. There is a slight surplus of fuel oil which may disappear with the further expansion of the European economy. Motor gasoline consumption approximates refinery output. To achieve this balance about 10 per cent of refinery throughput is traded between various O.E.E.C. member countries without raising total costs of transportation excessively.

Following on the shut-down of the world's largest refinery at Abadan (a seaboard-export refinery with a capacity of 500,000 b/d) in 1951, European refineries relying on Middle East crude oils were able to supply markets in the area of the Indian Ocean.[8] The construction of market refineries in Aden, East and South Africa, India, and Australia, also relying on Middle East crude oils, will reduce these exports substantially. However, a small volume of extra-European exports, e.g., to Africa, is expected to continue, which will balance approximately the importation of products from overseas, especially Dollar products from the Western Hemisphere.

EUROPEAN REFINERY PATTERNS

A country by country analysis discloses the following patterns:

Norway.—Consumption of petroleum products in Norway is now three times

[6] Freight rates for gasolines, kerosenes, and some of the middle distillates (so-called clean products) are slightly higher than for fuel oils, crude oils, etc. (qv). This freight differential appears to have little or no significance on refinery locations and re-exports of products.

[7] In 1951 commercial vehicles in Western Europe relied on gas-diesel oil for 34 per cent of their energy requirements, compared with only 4 per cent in the United States. O.E.E.C., *op. cit.*, Third Report, p. 13.

[8] For the first time in history, as a result of these exports, Suez Canal reports showed substantial petroleum shipments proceeding in a north-south direction, rather than in the usual south-north direction.

as large as before the war (40,000 b/d in 1952). The high requirements for fuel oil and gas oil for consumption in the merchant marine and fishing fleets, as well as the cost of distribution along the indented coastline from any plant location, have prevented the establishment of a refining industry. One small plant (1000 b/d) specializing in marine lubricants (high value products whose manufacture is geographically relatively footloose), and producing some fuel oils as a by-product, is located in southeastern Norway. All other Norwegian requirements are satisfied by importation. Thirty-one per cent of these imports have to be paid for in Dollars.

Sweden.—Swedish industry is generally equipped to burn both fuel oil and coal, and fuel oil consumption varies from year to year according to the price relation between fuel oil and coal. Despite these fluctuations, per capita consumption of petroleum products is, on average, the highest in Europe (in 1952, 216 U. S. gallons per year, compared to 106 in Great Britain, 78 in France, 27 in Portugal, and 714 in the United States). Two plants, one near Gothenburg (22,000 b/d) and one near Stockholm (11,000 b/d), refine about 30 per cent of the total requirements. An additional 2000 b/d is obtained from oil shale with methods "considered to be probably the world's most *nearly* economic shale oil operations."[9] Additional requirements of products are satisfied by imports, which up to 36 per cent have to be paid for in Dollars.

Denmark.—The consumption (40,000 b/d) and distribution pattern of Denmark resembles that of Norway. A small refinery (700 b/d), specializing in bitumen, is located in Kalundborg, and another specialty plant is under construction near Copenhagen. Products are imported, and have to be paid for in Dollars up to 25 per cent.

Iceland.—Consumption in Iceland increased sixfold between 1938 and 1945, yet it is too small (2800 b/d) and too unbalanced to warrant the construction of a refinery. Products are imported and are payable in Dollars up to 50 per cent.

United Kingdom.—In 1952 the United Kingdom consumed nearly one-third of West European requirements of petroleum products, and, thus, the new European refining policy resulted in the establishment of large refining capacities on British soil. Before the war, British oil companies, which own about 30 per cent of the world's known oil reserves, and produce currently about 16 per cent of world production, built refining capacities in areas of crude oil production rather than of product consumption. Exceptions were a refinery at Llandarcy (South Wales) built shortly before the war (1938 capacity about 20,000 b/d; today 90,000 b/d) and a few refineries of lesser significance at other British ports.

Although the United Kingdom is traditionally a coal consuming country, postwar shortages of coal have substantially raised the demand for fuel oil. Thus, petroleum product consumption has doubled since before the war, and consists today to nearly 40 per cent of the fuel oil requirements. In 1954 the United Kingdom expects to refine all its requirements of petroleum products (460,000 b/d), except for aviation gasoline, kerosene, and special lubricants. Total refining capacity is estimated at 600,000 b/d, thus leaving a substantial margin for exports which today exceed both the value of additional imports of petroleum products, as well as the value of British coal exports. Large refineries have been

[9] Quoted from the *Oil and Gas Journal*, Tulsa, December 21, 1953, p. 141. Italics by author.

established at the mouth of the Thames (90,000 b/d), near Southampton (140,000 b/d), on the Mersey (60,000 b/d), near Lancaster (36,000 b/d), and on the Firth of Forth (60,000 b/d), and medium sized and smaller specialized plants in these and other locations. Capacities are thus well distributed along the indented coastline. A further expansion of refining capacities now planned will also reduce imports of special lubricants bought from the United States at present. A plant at Pumpherston (Midlothian) (3500 b/d) also processes shale oil.

Eire.—Imports of products from British refineries cover the relatively small requirements of Eire (18,000 b/d).

Netherlands.—Due to the extensive use made of waterways for transportation, gas and diesel oil consumption in the Netherlands is as high as motor gasoline consumption (each over 15 per cent of total requirements of 90,000 b/d). Middle distillates thus form nearly 25 per cent of the total requirements; over 50 per cent of the total requirements consist of fuel oils. For this reason, the two refineries of the country, both located near Rotterdam (capacities 168,000 and 31,000 b/d), have relatively small cracking components. There are surpluses of gasoline and other products which are exported. These exports are nearly balanced by imports of products not produced in sufficient quantities by the refineries, as well as by imports permitted under a liberal trade policy to firms distributing in Holland but not owning any refining capacity there. Crude oil production from the largest oil field in Western Europe (Schoonebeek, near the German border) supplies over 15 per cent of domestic requirements; however, its output is expected to begin to decline during the next years.

Belgium and Luxemburg.—Like Holland, Belgium both exports and imports petroleum products under a liberal trade policy. However, Belgium contains seven refineries, six of which have smaller capacities than those of Holland (three have less than 3000 b/d each; the others have capacities between 11,000 and 40,000 b/d). All plants are located near Antwerp, except for one small plant in Ghent. Due to the absence of a large merchant marine, fuel oil requirements are not quite as significant as in Holland (about 40 per cent out of a total consumption of 77,000 b/d). For this reason the percentage of cracking capacities of Belgian refineries is higher than in Holland.

France.—France and Italy were the only countries which, by means of special import concessions, encouraged the location of refineries within their territories before World War II. For strategic reasons, refining capacities were well distributed along Atlantic and Channel tidewaters, as well as on Mediterranean lagoons. By balancing imports and exports, French refineries were able to supply French requirements of 110,000 b/d already in 1938. Since the war, refineries have been rebuilt and extended to cover a demand estimated at 266,000 b/d by the end of 1954, except for aviation gasolines, special lubricants, and petroleum coke (required for admixture with inferior local coals, as well as in the important aluminum industry). Installed refining capacity exceeds metropolitan French requirements by a substantial margin. In discussions with O.E.E.C., France insisted on establishing this excess capacity in order to supply the various areas of the French Union, either directly from France or by barter of products with foreign oil companies owning refineries better located to supply French overseas territories. The construction of this excess capacity

has been criticized as uneconomical.[10] An earlier writer, Leonard M. Fanning,[11] has also criticized the small size, as well as the dispersal of French refining capacities, although these are today on the average larger than, for example, Belgian refineries. Yields of fuel oil exceed requirements, and in recent years fuel oil occasionally has been exported to the United States. Including one resource refinery there are 13 plants in France. About one-third of the capacity is located near the Mediterranean, well over one-third along the Channel, and the remainder at the mouths of the Loire and Gironde. Plant capacities range from 12,000 b/d (Gironde) to 70,000 b/d (Etang de Berre).

Germany (West).—Since 1938 consumption in Western Germany has increased by only 56 per cent. This is due to the availability of coal as well as the depressed consumption levels in the first years after World War II. By 1954–55 German refining capacity is expected to be able to supply all German requirements of 153,000 b/d. The availability of coal explains the low rate of fuel oil consumption, and the extensive use of cracking processes resulting in gasoline yields of 30.5 per cent. German authorities believe that under these circumstances a return to hydrogenation processes for the manufacture of gasoline from coal (which supplied German wartime requirements) may be economical in the future. Twenty-nine per cent of the crude oil input in German refineries is of German origin. Market refineries located near Hamburg, Bremen, and the Lower Rhine are relatively small (10,000 to 39,000 b/d). In addition there are a number of small field refineries.

Switzerland.—Six-sevenths of Swiss requirements (27,000 b/d) are covered by products imported by barge up the Rhine, or by rail from Italy or France. Thirty per cent of these imports have to be paid for in Dollars. One plant (cap. 4000 b/d) is located near Lucerne, and receives its crude oil by way of the Rhine to Basle, and from there by rail.

Italy and Trieste.—Since 1948, Italian consumption of petroleum products has increased at the high annual rate of 28 per cent (1952 consumption, 148,000 b/d). Refining capacity was built to satisfy this growing demand. In view of the lack of local coal, 56 per cent of the demand is for fuel oil, which cannot be obtained economically at this rate of extraction from Middle East crude oil, and thus additional fuel oil has to be imported. However, such imports may cease during 1954, resulting in an even greater surplus of gasoline. Domestic supplies of crude oil cover at present only about one per cent of requirements. But, crude oil production as well as natural gas production in Northern Italy may increase rapidly. As in France, refining capacities are well distributed along the coast line, resulting in many small plants ranging in capacity from under 1000 b/d (Genoa) to 60,000 b/d (Naples). Two plants (6000 and 15,000 b/d) are located in Trieste. Unlike other European countries, Italy has market refineries supplied by pipeline from the nearest ocean terminal (three plants at Milan from 1000 b/d to 45,000 b/d). These are reported to be very efficient. In addition there are several small resource located plants, which, like similar plants in the United States, sometimes escape statistical enumeration.

Legally, Sicily has to be considered separately from Italy in all petroleum matters, for its autonomy permits local

[10] O.E.E.C. First Report, *op. cit.*, p. 52.
[11] "American Oil Operations Abroad," McGraw Hill, 1947, p. 117.

regulations of both crude oil production and refining. A refinery has been built at Augusta (13,000 b/d) against the advice of O.E.E.C., which considered this plant "not in line with the pattern of inland consumption requirements of Sicily and . . . uneconomic to reship products."[12] In general, O.E.E.C. has criticized the many small Italian plants.

Portugal.—Under the provisions of a prewar concession agreement one refinery located at Lisbon supplies one-half of Portuguese product requirements (about 20,000 b/d). About 54 per cent of imported products are payable in Dollars. The refinery is being expanded to supply some of the requirements of Portuguese overseas territories.

Greece.—In 1952, Greek consumption of petroleum products (23,000 b/d) was four times as high as before the war. Products are imported and a controversial plan to build a refinery has been abandoned.

Turkey.—(Member of O.E.E.C.). Since the war, consumption in Turkey (1952 estimate: 14,400 b/d) has increased nearly as rapidly as in Italy. Products are imported to cover Turkish requirements except for the southeastern inland region. Two-thirds of the imported products have to be paid for in Dollars, which consume 60 per cent of Turkish Dollar earnings. A small resource refinery near Diyarbakir is being enlarged to 6250 b/d, and may supply bitumen for the whole of Turkey.

Spain.—(Not a member of O.E.E.C.). Two refineries, one in the Canary Islands (Sta. Cruz, 26,000 b/d) and the other near Cartagena (30,000 b/d), and one lubricating plant near Barcelona (700 b/d) supply Spanish requirements except for specialties. The plant in the Canary Islands is significantly located, for it benefits from a relatively low standard freight rate ($4.95 per ton) for crude oil from Venezuela (where the owners of the plant have rights to crude oil production) compared with freight rates from Venezuela to the west coast ($5.65 per ton) or east coast ($6.95 per ton) of the Iberian peninsula. In view of this somewhat unique freight rate structure redistribution from the Canaries to Spain and its overseas territories appears to be economical.

Yugoslavia.—(Not a member of O.E.E.C.). The *Oil and Gas Journal*[13] reports five plants in Yugoslavia with a total capacity of 8000 b/d. Probably two of these plants near Rijeka (formerly Fiume) are market refineries; the rest are resource-located plants in Croatia.

Austria, Soviet Russia and Its Allies.—No reliable data are available for Austria or for Soviet Russia and its allies. Additions to capacities as well as new plants in the Soviet Union are all reported to be market-located according to Fifth Five Year Plan.[14]

Unfortunately no detailed data are available for an investigation of determinants of the location of refineries for most other countries, e.g., those of Latin America. However, listings of refinery locations and their capacities together with reports on unemployed, so-called shut-down capacities, published by governments or the petroleum press can be utilized for comparisons with the European refineries.

UNITED STATES AND WORLD REFINERY LOCATION TRENDS

Following the classification of refinery locations in Table I, the locations of refining capacities in the United States were found to be distributed as in Table II. The figures clearly show the

[12] O.E.E.C. First Report, *op. cit.*, p. 61.

[13] *Ibid.*, p. 139.

[14] Reported in *Petroleum Press Service*, monthly, London, October 1952, p. 348ff.

TABLE II

DISTRIBUTION OF OPERATING UNITED STATES CRUDE OIL REFINING CAPACITIES BY CLASSES OF LOCATION IN PER CENT OF U. S. CAPACITIES*

Year	U. S. Capacity (Barrels per day)	Location			
		Resource in Per Cent	Seaboard-Export in Per Cent	Total Resource and Seaboard-Export in Per Cent	Market in Per Cent
1920	1,530,565	60.8	15.9	76.7	23.3
1930	3,634,825	55.0	18.3	73.3	26.7
1940	4,196,694	45.0	25.9	70.9	29.1
1950	6,222,998	34.5	30.6	65.1	34.9

*Calculated from United States Department of the Interior, Bureau of Mines, Information circulars (annual). For methods of calculation, corroboration of types of location, see author's "The Location of Modern Petroleum Refineries," Ph.D. thesis, New School for Social Research, New York, 1952 (unpublished).

trend of United States refining capacities to locate away from areas of crude oil resources. Data for the intervening as well as subsequent years confirm the basic continuity of this trend. From the available information it appears probable that the trend to market locations would have been even more marked had not the demand for petroleum products in areas of crude oil production increased so substantially, e.g., in the Southwest.

According to the available data other countries show a similar trend for refining capacities to locate at markets (Table III). Recent reports of refinery construction and extension indicate that new capacities continue to be built predominantly in areas of consumption —e.g., in Mexico City and not near the Mexican oil fields; in Manaus and Rio de Janeiro, etc. (Brazil); the La Plata region; Durban (South Africa); Mombasa (Kenya); Bombay (India); Freemantle (Australia); and in other countries. Reported increases of refining capacities in seaboard-export locations throughout the world are of much lesser significance. Very few resource refineries are being built; in contrast, for example, to the period of World War I, when a new refinery at Caspar, Wyo. (60,000 b/d) was reported to be one of the largest then in existence in the world. The dismantling of refining capacities is reported primarily for resource locations, and can usually be correlated to exhaustion of local oil fields.

CAUSES OF TRENDS

The growth of market refineries can be correlated with a decrease of losses of materials in the refining process, e.g., with modern methods a ton of crude oil can be made to yield nearly a ton of products. Reductions of losses in processing vary according to types of plant, as well as according to the origin of the crude oil utilized. In general, therefore, trends in the geographical distribution of refining capacities confirm Alfred Weber's[15] observations on the effect of weight-losses in processing as a determinant of plant location between the source of the raw material and the area of consumption. No cost data on determinants of locations are, however, available.[16] In interviews, especially after the beginning

[15] C. J. Friedrich: "Alfred Weber's Theory of Location," University of Chicago Press, Chicago, 1929.

[16] For a discussion of the reasons for the absence of such data see J. S. Bain: "Economics of the Pacific Coast Petroleum Industry," University of California Press, 1944; also various U. S. Congressional Committees of Enquiry.

TABLE III

DISTRIBUTION OF REFINING CAPACITIES BY CLASSES OF LOCATION*

(In thousands of barrels per day)

Area	*Market Located*		*Resource and Seaboard Located**	
	1940	*1950*	*1940*	*1950*
Canada	165	356	38	68
Latin America	135	261	683	1,082
Middle East	20	146	407	841
Western Europe	344	872	1	2
United States	1,222	2,174	2,975	4,099
Others (India, etc.)	4	18	10	11
Total	1,890	3,827	4,114	6,053
Percentage Distribution	31.6	38.5	68.4	61.5

*Calculated from data assembled by the *Oil and Gas Journal* in annual reports. East European, Far Eastern, and Southeast Asian capacities are excluded. The author believes that the excluded refining capacities will not affect substantially the conclusions of this study. Unfortunately, few reliable data are available for years other than 1940 (which generally presents prewar capacities) and 1950 (which represents capacities prior to the Korean war and the Anglo-Iranian oil conflict).

*Outside the United States and Canada these are primarily seaboard-export located capacities.

of the Anglo-Iranian oil dispute, oil company executives have indicated, that political motives, i.e., fear of expropriation of valuable refineries, are also responsible for the trend to market locations, since, generally speaking, areas of crude oil production are believed to be less stable politically than industrialized countries of consumption. However, this explanation does not account for the growth of market refining capacities in the United States, nor in some other unindustrialized countries like India, although this motive may have assisted the growth of the European refining industry and deterred investment in the Middle East which supplies most of Europe's crude oil. Several crude oil producing states or countries have legislation compelling the refining of their crude oil within their territory, e.g., Wyoming for oil produced on state lands, or Venezuela, where one-tenth of the oil produced and exported under the provisions of the 1943 Petroleum Law has to be refined in the country. These laws have been criticized as leading to uneconomic investments, e.g., in United States Congressional Hearings, and their effect on the world-wide distribution of refining capacities has been very limited.

CHARACTERISTICS OF UNITED STATES LOCATIONS

For the United States, unlike all other countries, data for unemployed (shut-down) capacities are also regularly available. Analyzed by types of location these data indicate that market-located capacities suffer less from unemployment than seaboard-export or resource capacities (Table IV). These statistical data confirm the impression obtained in interviews with oil company executives that market refineries in the United States supply generally only minimum local demand, and that any additional requirements are satisfied by shipments from resource or seaboard refineries, which thus suffer from far wider fluctuations of employment. In this respect there are, therefore, similarities between United States market refineries and the European refining program.

One of the major phenomena in the

growth of the United States refining industry is the increase of refining capacities on the East Coast since 1920. This regional expansion is about paralleled by the increasing substitution of fuel oil for coal in the area. The composition of the demand for petroleum products has thus become more concordant with the composition of crude oils (primarily United States Gulf coastal and Venezuelan) available for shipment to this area. Similar to the changes in Europe since the end of the war, such changes induce the location of plants in the area of consumption. Today, the extremely high additional requirements for fuel oil in winter are supplied by imports of fuel oil from refineries on the Gulf coast or the Caribbean.

Other sections of the United States, e.g., the North Central States, can receive supplies of both crude oil and products by pipeline, in addition to some deliveries by barge in summer. However, "heavy fuel oil flows so slowly, particularly when ground temperatures are low, that their movement for long distances by pipeline is usually impossible. Though lighter fuels can sometimes be pumped, the flow remains laminar, and considerable mixing occurs if different grades are pumped successively down the line."[17] For this technical reason increasing fuel oil consumption has induced the location of refineries in areas of inland consumption. In general, therefore, increasing fuel oil consumption appears to be also a major factor in the causation of the world-wide trend of refining capacities to locate in areas of consumption.

[17] Quoted from "Transport of Petroleum to the United Kingdom" by M. E. Hubbard & D. C. Ion, paper presented at the summer meeting of the Institute of Petroleum, London, June, 1953, p. 10. Products other than fuel oils flow differently and can be easily pumped successively in pipelines.

TABLE IV

SHUT-DOWN CRUDE OIL REFINING CAPACITIES AS A PERCENTAGE OF OPERATING CRUDE OIL CAPACITIES BY TYPES OF LOCATION

Year	*U.S.*	*Market*	*Seaboard Export*	*Resource*
1930	3.6	0.7	4.4	4.7
1931	6.4	4.1	4.5	8.2
1932	10.8	3.5	5.2	16.8
1933	12.9	5.4	3.0	20.5
1934	10.3	1.2	4.8	17.5
1935	12.3	1.5	1.4	21.1
1936	9.8	1.4	2.1	18.0
1937	8.3	1.1	1.4	15.5
1938	9.4	6.0	0.9	17.0
1939	14.6	12.4	5.4	21.8
1940	10.3	7.6	3.6	16.5
War years—no data released				
1947	4.4	0.8	4.9	7.0
1948	3.6	2.4	1.2	6.7
1949	3.4	1.8	1.6	6.9
1950	7.6	4.6	9.4	9.1

CONCLUSIONS

Analysis of the trends of geographical distribution as well as studies of the determinants of location indicate that the European refining program, despite its accent on savings of foreign exchange, and possible political motives, does not run counter to trends observed in other parts of the world. The observations on the determinants of location also explain why some countries have to continue to spend precious foreign exchange on the purchase of petroleum products rather than build refineries within their territories. For this reason, the world-wide trend to market refining has not prevented a further growth in other types of location which supply products to areas of insufficient or unbalanced demand. Since most of these areas, like Europe, can be supplied by tanker, this expansion has taken place primarily in seaboard-export locations and not in resource refineries.

THE IRON AND STEEL INDUSTRY OF TURKEY

Erol Tümertekin

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AFTER World War I many countries, including Turkey, began to build up their iron and steel industries. For an agricultural country, Turkey has done surprisingly well, and now produces enough iron and steel to take care of at least 50 per cent of its needs. Fortunately, Turkey possesses all of the raw materials necessary for a successful iron and steel industry, and in recent years has produced 120,000 tons of pig iron and 100,000 tons of steel annually.

There is no doubt that there are many deficiencies and disadvantages in the country's present system of iron and steel production. One of the more serious of these is the lack of adequate transportation facilities. For example, iron ore must be transported 600 miles overland from Divrik to the steel mills at Karabük. However, despite these drawbacks, there are sufficient reasons for a continued development of the Turkish iron and steel industry. Among the more important of these reasons is the rapidly growing market for iron and steel products within Turkey. And in addition to the domestic market, many of the neighboring countries that have no iron and steel production can be considered as a potential future market.

At the present time, there is no clear idea as to the extent of the reserves of raw materials. Several estimates have been made in three different regions—the Ereğli-Zonguldak coal basin (over a billion tons), the Divrik iron mines (40 million tons), and at Çamdağı (52 million tons). However, there are many other iron ore deposits the extent of which has not yet been estimated. Authorities are beginning only now to study their possibilities.[1]

Historical Outline

Recent studies and excavations have shown that the Anatolian Peninsula (Asia Minor) was probably the "cradle of the Iron Age."[2] According to our knowledge, "the Hittites were the first people to make satisfactory use of iron. How early the Hittites discovered the value of this iron ore and how to make it serviceable is uncertain, but all available evidence goes to show that they retained a monopoly of the industry until the fall of their empire about 1200 B.C."[3] We have reason to believe that even before 1350 B.C. iron goods reached Egypt from this source.

From the end of the Hittite Empire until the beginning of the Ottoman Empire, and particularly during the Byzantine and Selçuk periods, there

[1] A recent study of Turkey's iron ore deposits can be found in the "Symposium sur les gisements de fer du Monde." Tome 1, XIX'e Congrès Géologique International, Alger, 1952.

[2] Harold Peake: "The Origin and Early Spread of Ironworking," *Geogr. Rev.*, Vol. 23, 1933, pp. 639–652.

[3] Harold Peake: *op. cit. See also:* Keilschrifttexte, aus Bogazköi, I, pp. 14–20; A. Götze, "Kulturgeschichte des Alten Orients, Kleinnasien," München, 1933, p. 102; G. Contenau, "La Civilization d'Assyrie et de Babylone," Paris, 1937, p. 131.

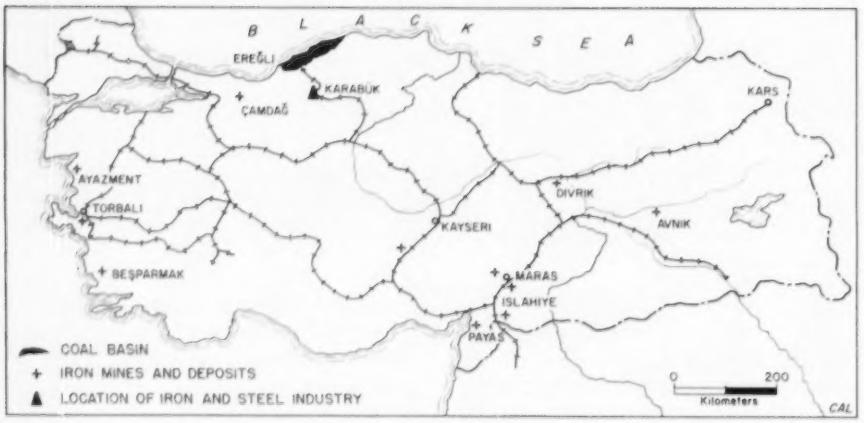

FIG. 1. Raw materials for Turkey's iron and steel industry.

were important iron works in the Anatolian Peninsula and in Thrace. Unfortunately, however, it is quite difficult to find accurate information about them. Beginning with the Ottoman Empire, it is much easier to find documentary evidence that there were many active iron works in Anatolia and Thrace. Bilecik, Kığı, Semakov, and Demirköy were among the more important of these. There were ironworks also at Divrik and Sivan.[4] The production from all these ironworks was used for military purposes.

After 1839 a great effort was made to establish new iron and steel plants. As a result of these attempts, the Zeytinburnu iron and steel plants (near Istanbul) were established, though activities were suspended after a short time. After that nothing more happened until 1925.

As soon as Turkey became a Republic, attempts were made to establish a regular iron and steel industry. The first attempt in 1925 failed for lack of an adequate market. A later attempt in 1928 was also unsuccessful. In 1932 the Ministry of Economics reconsidered the whole project, and as a result of their efforts, the iron and steel industry of Karabük was opened in 1939.

Karabük is near the Black Sea coast, 45 miles from the Ereğli-Zonguldak coal basin and 600 miles from the Divrik iron deposits (see Fig. 1). When the site was chosen, it was thought that the furnaces would use imported ore, and that, therefore, it would be wise to be near the coal basin and at the same time close to the coast to facilitate the transport of imported iron ore. During World War II importation of foreign ore was almost impossible. And in addition to this, the rich iron ore deposits at Divrik were opened up. In this manner, the Karabük plant began to use domestic ore, and has been using it ever since.

RAW MATERIALS

Although there are more than 20 iron ore deposits in Turkey, only one, the Divrik Iron Mine, has been developed. This mine alone supplies all of Karabük's needs. The total reserve in the Divrik area is estimated to run to 30 or 40 million tons. Another iron deposit, believed to be substantial in

[4] Moltke: "Briefe über Zustand und Begebenheiten in der Türkei aus den Jahren 1835 bis 1839," Berlin, 1911, p. 304.

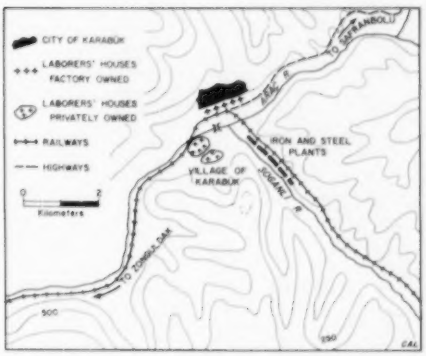

FIG. 2. Setting of Turkey's iron and steel industry.

size, has an iron content of only about 40 per cent and is situated in Adapazarı near Izmit in Western Anatolia.

The state-owned Ereğli-Zonguldak coal basin contains the only operating bituminous coal mines in Turkey. Fortunately, a vast field of bituminous coal lies along the coast of the Black Sea, where adequate port facilities are available. Though the existence of coal has been known for over a century, the richness of the deposit is uncertain.[5] Several estimates show deposits from 300 million to one billion tons, but however much they amount to, they are large enough to supply not only the rapidly expanding need for fuel on the part of Turkish industry and individuals, but also to support a profitable export trade.

Seventy-six per cent of the coal in the Ereğli-Zonguldak region is suitable for making metallurgical coke. The Karabük iron and steel plants use about 15 to 17 per cent of the yearly production from the Ereğli-Zonguldak basin, averaging 350,000–400,000 tons annually. This consumption makes Karabük the second largest consumer.

[5] Ali Tanoğlu: "Iktisadi Coğrafyası, Enerji Kaynaklari," 1950, Istanbul. Much information about Turkey's energy resources appears in this source, and the author gives coal an important place among them.

TRANSPORTATION

Although the Karabük plants are situated in a valley between two rivers, the rivers are not navigable. Nor are there good highways around Karabük. Therefore, transportation is confined almost entirely to rail haul. All raw materials are brought from the mines by railways, and the production of the plants is also sent out by rail. The coastal cities get their share of the production by ship from the port of Zonguldak. Of these, the most important and largest is, of course, Istanbul.

LABOR

Turkey's iron and steel industry has a labor force of 4000. Of this number, 61 per cent come from the Black Sea region, especially from the eastern sections and from Karabük and Safranbolu. The rest come from central, western, and southern Anatolia. A few also come from Thrace. The reason so much of the labor comes from the eastern Black Sea region is due to the fact that the narrow fertile coastal strip has the highest population density in the country (200 persons per square

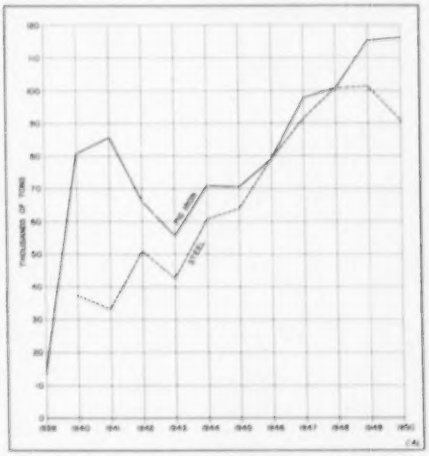

FIG. 3. Iron and steel production at Karabük.

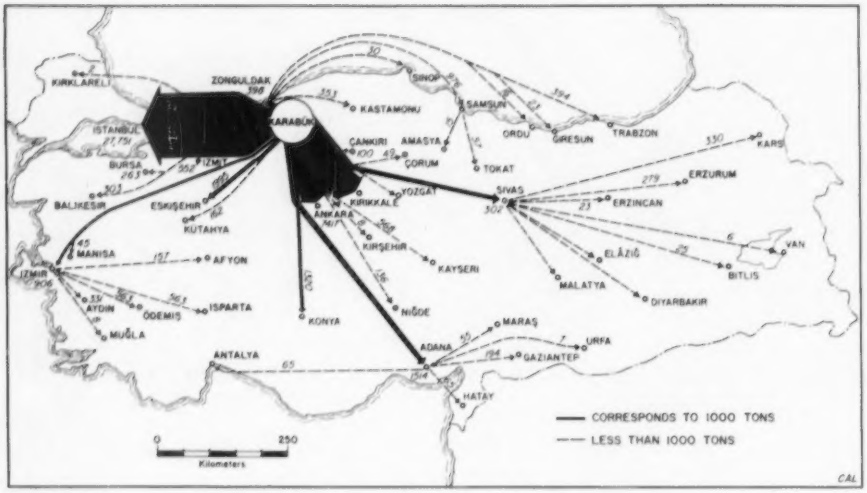

FIG. 4. Flow of iron and steel from Karabük.

kilometer). The industrial and agricultural development of the region has not been sufficient to support the entire population, and for this reason many of the Black Sea people moved westward to work in the mines and factories.

SETTLEMENT

Except for a primitive village of only 16 homes, Karabük was uninhabited before the establishment of the iron and steel factories. Because of this, housing was a crucial problem at first, and it was necessary to build houses and develop a new settlement. Today, there are about 2000 nice houses along the Araç River and its terraces. The factory settlement also has its own hospital, a large grocery store, a hotel, movie theaters, and parks. All the buildings belong to the factory and are intended only for the use of factory personnel. The houses are rented to the staff, technicians, and laborers very cheaply. The company runs free bus service between the settlement area and the factory. Since the company does not permit the building of private houses or commercial institutions within its territory, a separate settlement has sprung up along the banks of the Araç River. In this new settlement, officially called "Istasyon Havalisi or Station District," hotels, small restaurants, grocery stores, barber shops, etc. can be found. Simple houses for laborers can also be found on the left bank.

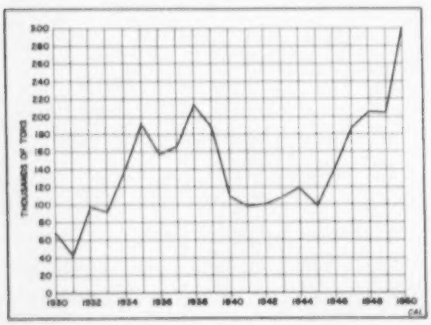

FIG. 5. Consumption of iron and steel in Turkey.

Altogether, the Karabük area has a population of 14,000. This has been called a city, but since it is so directly controlled by the factory, we prefer to call it "Karabük Factory Settlement Area."

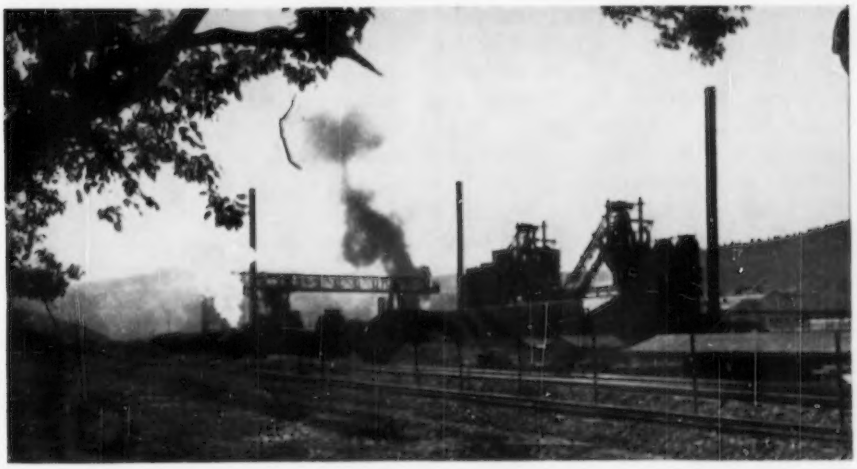

FIG. 6. Industrial scene at Karabük.

FIG. 7. Rolling mill at Karabük in the Soğanlı River valley.

PLANTS AND THEIR SITUATIONS

The plants are all situated on the right bank of the Soğanlı River.[6] The valley there is the only flat section in the entire region, so all the buildings have of necessity been built there (Fig. 2). For the same reason the plants have been strung along the narrow strip by the river, in a north-south direction. The main plants include blast furnaces, rolling mills, steel furnaces, a coke factory, a pipe factory, a power station, and some others such as sulphuric acid and phosphate works.

[6] The length of the Soğanlı River Valley is about 900–1000 meters, and the valley is only 300 meters wide.

PRODUCTION AND MARKETING FACILITIES

The production of the Karabük plants began in 1939, as soon as the blast

furnaces and rolling mills were constructed. After the construction of the steel mill in 1940, steel and pig iron production also was started (Fig. 3). Today, the production of the plants is near capacity, and it is evident that the only way to further increase production is to build new plants.[7] Many plans have been drawn up for this increased production, one of which would increase the finished steel capacity at Karabük by 180,000 tons annually.

The markets for the products of the Karabük plants are mainly in the cities of Ankara and Istanbul, and in the smaller cities of eastern, southwestern, and northern Anatolia (Black Sea regions) (Fig. 4). Istanbul is the largest consumer. In fact, it also imports large amounts of iron and steel. The western and southern regions along the coast do better by importing iron and steel, because the cost is lower and transportation facilities are better for imported iron and steel. Therefore, Karabük's production is of more use in central Anatolia than it is in the south (Fig. 4). As we have pointed out before, a large part of Turkey's iron and steel needs have been supplied by import (Fig. 5).

[7] Two blast furnaces have a capacity of 350,000 tons annually (one of them is always in reserve), the capacity of the steel furnaces is 150,000 tons a year. The rolling mill has a capacity of about 75,000 tons.

CONCLUSION

It seems evident that Turkey possesses reserves of iron ore and coal capable of supporting an iron and steel industry of moderate size. The most important factor in increasing production is to develop iron ore and coal mining. The need for improved transportation facilities is equally important, so that raw materials can be brought to the factory and so that production can be carried to the markets.

BOOK REVIEWS

The Tropical World, by PIERRE GOUROU, translated by E. D. LABORDE. xii and 156 pp.; maps, ills., notes, index. Longmans, Green and Co., London, 1953. $3.50 (18 shillings). 8¾ x 5½ inches.

Although most professional geographers with tropical interests have probably read Gourou's *Les Pays tropicaux* in the original, Mr. Laborde's translation will be most useful in school and college libraries. A translated book as a rule calls for review under two aspects: as a translation and as a book in its own right. Mr. Laborde has for long almost monopolized the Gallic fields, and many of us will recall from our earliest student days his success in Englishing the delicate and supple prose of Vidal de la Blache's *The Personality of France*. The present translation is perhaps not quite up to Mr. Laborde's best level, although it must be said at once that it is in general both readable and reliable.

The typescript was read by Professor Gourou, so that divergences from the sense of the original may represent the author's own amendments rather than errors of the translator. In the reviewer's opinion there are a number of unhappy renderings, sometimes blurring the point of metaphor or antithesis in the French. But nearly all are either trivia or at least defensible alternatives, for example the repeated use of the stilted archaism "in fine" for *en somme;* it would seem more appropriate for *enfin* (in its summating sense), but even then it is hardly good modern English. A somewhat similar lapse is the use of the surely obsolete or dialect "denshired" (etymologically from "Devonshire") for *brûlis* (p. 32 fn.); it is a large dictionary which contains this word, and "burnt-over" would have done quite as well.

In a few places discrepancies between French and English can hardly represent Gourou's second thoughts. Thus on page 46/51 (the second figure in these references is to the original) *ravagé par le paludisme* means "ravaged by malaria" and not Laborde's "pitted with marshes"; "tilled" is very odd for *apprécié* (69/82). In at least two places a definitely wrong interpretation is offered. On page 133/161 Laborde has "Native agriculture . . . has the advantage, therefore, of lending itself to producing export crops"; the French is *a donc avantage à s'orienter vers . . .*, say "may advantageously turn towards." On page 66/78 there is a complete inversion of the sense: *Mais l'influence des faits de civilisation ne saurait être négligée*—a remark very typical of Gourou's thinking—becomes "Nor can the influence of the environment on cultural features be neglected." This mistake is the stranger in that the immediately preceding sentence has pointed out an environmental factor, so that Laborde's version is tautologous as well as inaccurate.

Two slips of a different nature may be mentioned. On pages 48 and 50 the break-up of the *older* Mayan Empire is put in the 16th century and 400 years ago instead of the 6th century and 1400 years ago; and on page 103/123 a failure to complete a conversion leads to 2800 and 1800–2000 kilograms per hectare becoming respectively one ton and 4000–5000 lbs. per acre.

But by and large Mr. Laborde represents his author accurately. The production of the book is greatly superior to that of the French original: type and paper are better, maps have been redrawn and made much clearer, and the photographs are a valuable addition. The translation also contains new material from Gourou, short additions scattered through the text; the most interesting of these refer to Brazil. On the other hand the original index of authors is omitted, and the general index, though more clearly arranged, is reduced from over 800 to under 300 items.

The main theme of the book itself can be stated quite briefly. Except for India and parts of Southeast Asia, the tropical lands are the domain of shifting cultivation, which is as a rule able to support only a feeble density of population. This cultivation, where perfected and where population pressure does not enforce a too-rapid return of cultivation, does not necessarily lead to destruction of the generally poor soils, but the system has no surplus, as it were, and so can never secure a reasonably high standard of living. The general poverty precludes any marked amelioration of health; dense populations are a cause rather than an effect of healthy regions, since they bring the total area under human control and so stamp out the foci of disease. Parenthetically, a convincing case is made out for this view in respect of malaria (doubtless the most universal scourge), but other diseases are not discussed in detail from this aspect.

But under the European peace, accompanied by at least some medical reform, the populations have tended to increase and the same land must be cultivated more often, while ill-considered "improvements" (e.g., in some areas the replacement of the hoe by the plough) have also

played a part in the ensuing erosion and deterioration of the soil. Moreover, in many cases the old systems, well adjusted to their environments, have been subverted by the impact of the world market, demands for labor, and cash economy; to say nothing of flagrant robbery as in Kenya. If social decency for the tropic lands is to be attained, it is essential to find a substitute for shifting cultivation. Gourou rightly scouts the idea of attempting to introduce peasant mixed farming such as exists in western Europe; he finds the solution in wet rice and plantations of tree-crops, using methods which experience shows not to endanger the soil. For already crowded areas, such as India, a smaller but more effective rural population is essential for advance. Industrialization is thus needed to absorb surplus or displaced population, though the not too favorable resources base must be borne in mind; rural artisan production should be modernized by hydro-electricity and find markets not only through the increased regional specialization implied (but hardly discussed: a tantalizing omission!) but perhaps also abroad, for goods not exposed to competition from mass-production (page 148/182; but are there any of significance?). The future of the tropical lands is seen as essentially an extension of their present: as the major suppliers of fibers, vegetable oils, and beverages; though the dangers of synthetics are noted, and the likely lessening of the existing price-advantage of tropical countries as wage-levels rise. The temptations and the dangers of autarchy are examined.

All this is argued with much vivid illustration, with a fine grasp of detail coupled with broad but penetrating insight into the multiplex problems of environment and society. A number of criticisms could be made; to give one example only, it is a pity that in a book brought up to date in 1952 there should be several references to the Bombay Plan (1944), under which the major production increases would have been in banknotes of the loftier denominations, and none to the Indian Five Year Plan (1951), which goes much beyond Gourou's advice that India should follow Puerto Rico and not actually outlaw birth control propaganda.

The heart of the matter is in the conclusion, a few pages packed tight with solid and wide-ranging argument on the fate of tropical man. Gourou's optimism is sturdy, but much qualified. So indeed it must be; for in the last resort it is not technology that we lack. If all the research institutes shut down tomorrow, we should still have the *technical* skills to solve the material problems, to support even in India more people at a higher level. But we have no time, given the torrents of new mouths to fill; and as for the *social* skills needed to help the tropical peoples to apply our technology without disintegration of culture, society, and ultimately personality—there we still fumble in the dark. This is the gloss on Gourou's final words: "nothing worth while will be realized if the attention of the modern world is focussed solely on the means of living. What is needed even more is an art of living." I think that human geography, if it lives up to its name, can give largely to the creation of that art.

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The Economics of Location, by AUGUST LÖSCH, translated by William H. Woglom with the assistance of Wolfgang F. Stolper. xxvii and 520 pp.; tables, diagrs., name index, subject index, index. Yale University Press, New Haven, 1954. $7.50. 6 x 9 inches.

American economists and geographers who have toiled over this work in the original German owe a profound debt of gratitude to the translators and editors who have done a remarkably fine job of making it available in English. Lösch's work in location economics has long been recognized as the most comprehensive treatment yet undertaken; but, like all scholarly writings in this relatively undeveloped field, it is not easy reading, even in its present splendidly translated form. Yet there is strong justification for the feeling that a general familiarity with Lösch's methods and findings should be an essential feature in the training of every serious student of economic geography.

August Lösch cherished an ambition to produce a body of economic theory whose frame of reference would be spatial rather than temporal. His approach employs assumptions and methods that are commonly employed by economic theorists. The emphasis is primarily upon human motives and the economic processes engendered by them. Analysis proceeds by first determining how these forces would affect the location of economic enterprises under highly simplified conditions. Later an attempt is made to introduce additional factors into the models in order to bring them nearer the conditions of actual life. In no case, however, do any of these analysts find it possible to consider enough variables to enable them to explain or predict specific locations. Their function is rather to establish the general character of the mechanisms which produce locational patterns.

To the typical geographer, who is apt to be accustomed to dealing with concrete situations, the lack of specificity in Lösch's approach will doubtless be alarming. Certainly there is no formula that will explain the location and importance of a Detroit or a Chicago, or any other specific agglomeration of economic activities. On the other hand, there is an array of hypotheses that have already proved useful in geographic analysis and give promise of much greater usefulness in the future. Specifically,

these hypotheses are concerned with the location of economic phenomena such as factories, farms, trade areas, cities and villages under the conditions postulated in the analysis. These hypotheses appear to provide the most acceptable points of departure for studies of the locations of specific earth-bound phenomena. Numerous writers (such as Brush, Ullman, Harris, and Hartman) have made good use of these constructs in studies of the locations of cities and sizes and shapes of trade areas, business districts, and the like, by determining how actual, specific situations resemble or differ from these hypothetical ones, and pointing out reasons for those similarities and differences.

Lösch was able to draw on a wide variety of well-known theoretical works as well as the products of a large research staff at the Institute for World Economy at Kiel. Economic geographers will encounter many familiar concepts in these materials: Alfred Weber's use of weight-loss and isodopanes, with Lösch insisting that maximum profit rather than least cost should be the dominant criterion in locational studies; Thünen's rings, descriptive of the effect of a central market on patterns of agricultural land use; and Christaller's concepts of central place and hexagonal market areas, which are here expanded into a complex model encompassing the distribution of various types of commodities and the location of various sizes of urban centers. Lösch's criticisms and elaborations of these findings are, on the whole, both brilliant and useful, in spite of the fact that in some cases they may seem to have been elaborated unduly!

It was not to be expected that the author's dream of producing a complete and consistent body of theory would be realized. Lösch himself thought of this volume as a progress report, a possible beach-head that might serve as a base for further advances. One finds, for example, little co-ordination among the treatments accorded the individual topics considered in various parts of the book. Finally, there is a splendid review of the factual literature on these topics (based mainly on conditions in the United States), but the author apparently had no opportunity to relate those examples specifically to the theoretical materials which comprise the remainder of the volume. On the whole, however, the volume presents an excellent review, amalgamation, and elaboration of the best thought on the various topics commonly included under the term "economics of location."

In retrospect, it appears that Lösch's greatest contribution to the training of economic geographers may well lie in his convincing arguments to the effect that the location of economic activities is an essentially orderly process, and that the forces which activate this process may be identified and measured. Lösch, to be sure, is concerned almost exclusively with those factors and forces that are economic in character, but in that area he provides excellent methodological background for the geographer who has long been prone to give major emphasis to the more tangible factors observable in the natural environment.

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Le Brésil; Structure sociale et institutions politiques, by JACQUES LAMBERT. 165 pp.; no maps. Librairie Armand Colin, Paris, 1953. $6\frac{1}{8}$ x $9\frac{3}{8}$ inches.

This monograph by Jacques Lambert, in which the social and political structure of Brazil is analyzed, merits the attention of persons interested in the political geography of Latin America. Although it suffers from certain of the difficulties commonly found in the works of non-geographers, it does contain many observations fundamentally important to political geography, yet of the kind often overlooked by professional geographers.

The book is divided into six chapters. The first discusses the general characteristics of Brazil—the diversity of economic, social, and political conditions and of the basic resources; the difficulties of communication; and especially the position of Portuguese Brazil in a continent which is otherwise Spanish in its dominant culture. The author then proceeds to a treatment of Brazil's demographic situation, pointing to the rapid rate of population increase, the immigration of foreigners which has now almost ceased, and the internal migrations especially from the Northeast to the south, and from the rural areas to the cities. He recognizes that although Brazil's great cities are growing more and more rapidly, the population remains (1950) about 72 per cent rural. Lambert then discusses the mixture of ethnic and cultural elements that have entered into the Brazilian mixture, and underlines the enormous contrasts between the well-to-do landowners, the urban industrialists, and the landless farmers. One chapter deals with the economic base of Brazil, pointing once again to the speculative nature of the economy and to the lack of capital. The last two chapters, in which are to be found the author's most important original contributions, deal with the political institutions and with Brazil's international relations.

Perhaps the most important fact about Brazil's geography is the enormous contrast between the region known as the Southeast, including especially São Paulo and its hinterland, and the rest of the country. The State of São Paulo alone produces more than a third of the wealth of Brazil. Something like 80 per cent of the new urban industrial development currently appearing in Brazil is either in or in the vicinity of Rio de Janeiro and São Paulo. Fur-

thermore, the tempo of economic life, the structure of society, and the actual functioning of the political institutions in this rapidly growing area contrast in fundamental ways with these conditions in other parts of the country. Lambert paints in vivid terms the enormous contrast between Brazil's two great population centers: the Northeast and the Southeast. The former he describes as an old colonial land, from which the chief export is people; the latter he describes as a new country, in process of rapid development. Like Hartshorne (in the chapter on Political Geography in *American Geography, Inventory and Prospect*), Lambert describes certain of the outlying States of Brazil as having an essentially colonial status which the contiguity of territory sometimes obscures. The political institutions, modeled on paper after those of the United States, actually operate very differently in different regions. In most parts of Brazil, in spite of the forms of government, nothing approaching political democracy actually exists. The politically powerful minority is made up of large landowners, politicians, officers of the army and the police: the great majority of the people play no part in the political life.

Lambert's analysis suffers from the usual lack of geographic procedures. The fact that the book contains not one map is a symptom of the failure to be concerned in the text with precise differences from one place to another. For example, when Lambert insists that Brazil's population is maritime, being concentrated in a belt of concentrated settlement along the coast, he is viewing population enumerated by States, not within States. The people who live in the mountains of Espírito Santo are no more closely connected with the ocean than are those of Minas Gerais. In the Northeast the emptiness of the immediate coast is a feature of the population map when examined in detail. And in the Northeast as well as elsewhere in Brazil, the clusters of people are separated by thinly peopled country, even in the well-populated zone along the coast. The outline of Brazil's populated area is related, not to the coast or accessibility to a port, but to a particular kind of natural vegetation, a particular kind of agricultural land. The regional divisions that Lambert uses have the advantage of simplicity: the old Northeast; the New South. But this simplicity obscures the important fact that the hinterland of Rio de Janeiro is an "old" area of settlement in contrast to São Paulo, and that there are "new" colonial areas in the midst of the generally "old" lands of the Northeast. Furthermore, São Paulo is not to be confused with the South of Brazil, which begins with Paraná, where political, social, and economic conditions are strongly contrasted with the Southeast and the Northeast. In other words, Lambert's attempt to point to basic regional divisions of Brazil may have the effect of obscuring the even more complex picture of Brazil's political geography.

It is always difficult to judge whether such criticism of geographic procedures is or is not justified. Probably most persons interested in Brazil's political structure would agree with Lambert that the fundamental difference is between Brazil's Northeast and Brazil's South, and that additional areal differences only confuse the picture. The geographer, being especially concerned with the contrasts and similarities from place to place, perhaps succeeds only in blurring the simplicity of a two-fold regional division of Brazil. Lambert certainly represents a vast advance over those sociologists, economists, and political scientists who, in the past, have offered generalizations purporting to describe Brazil as a whole.

The concluding chapter of the book is of great interest, however one may feel about the internal divisions of the country. Here Lambert deals with Brazil's international relations. He weighs the significance of the inter-American system with the traditional cultural ties with France. Brazil, he points out, has tended to side with the United States in hemisphere international relations in order to counter-balance the Spanish-American bloc. That the countries descended from Spain are so numerous, whereas Brazil has remained under one government, has the effect of giving the Spanish countries a place in international organizations all out of proportion to the population. In the cultural field, as contrasted with the field of politics, Brazil should tend to side with France. Lambert sees a growing tendency to make Spanish a third international language, along with French and English. But, says he, if one permits the rise of Spanish, so pleasing to the Spanish-speaking countries, this would have the effect of reducing the importance of French and giving increased importance to English which would then become dominant. Where Anglo-America is so much stronger in the economic and political fields, Lambert feels that it would be most unfortunate to permit English to become dominant in the cultural field. We must be inclined to agree with his analysis.

If Latin America is ever to develop a bloc of nations that might approach balancing the preponderant position of the United States in hemisphere affairs or in the United Nations, Lambert foresees that Latin bloc organized, not around Argentina, but around Brazil.

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